



***MultiStim***  
***8-Channel Programmable Stimulator***

**3800**

**INSTRUCTION MANUAL  
FOR  
MULTISTIM 8-CHANNEL  
PROGRAMMABLE STIMULATOR  
  
MODEL 3800**

***Each 8-Channel Programmable Stimulator  
delivered complete with:***

***10' USB Cable  
Rack Mount Hardware***

***Version 5.0  
March 2020***

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## **WARNING**

THIS EQUIPMENT IS NOT INTENDED FOR USE WITH HUMAN SUBJECTS IN ANY WAY.

### **Document**

The information contained in this manual was as accurate as possible at the time of publishing, but is subject to change without notice and should not be construed as a commitment by A-M Systems. Changes may have been made to the hardware or firmware it describes since publication. A-M Systems, reserves the right to change specifications as required. For the latest information please check our website (<http://www.a-msystems.com>) or contact A-M Systems, directly.

Manual Document Number  
**5027908** Rev 05

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### **Safety**

This instrument is provided with terminal for protective grounding. Before applying power, verify that the correct safety precautions are taken (see the following warnings). In addition, note the external markings on the instrument that are described under Safety Symbols. Do not operate the instrument with its cover removed. Replace fuse only with specified type.

### **Supply Voltage**

This equipment can be operated at 120V or 220V as determined by the position of the fuse box on the rear panel. The unit can operate at wither 50Hz or 60Hz; no adjustments are necessary. Other voltage/frequency combinations are not recommended unless the manufacturer is contacted before first usage.

## **WARNING**

Do not attach a line voltage that does not match the line voltage specified on the rear panel.

Before turning on the instrument, you must connect the protective earth terminal of the instrument to the protective earth conductor of the (mains) power cord. The mains plug must only be inserted in a socket outlet with a protective earth contact.

Service should be performed by trained personnel only. To avoid dangerous electric shock, do not perform any service unless qualified to do so.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a safety hazard.

### Safety Symbols



The product is marked with this symbol when it is necessary for you to refer to the instruction manual in order to protect against damage to the product.

## **WARNING**

The Warning symbol calls attention to a procedure or practice, which, if not correctly performed could result in injury. Do not proceed beyond a Warning symbol until the indicated conditions are fully understood and met.

## **CAUTION**

The Caution symbol calls attention to a procedure or practice, which, if not correctly performed could result in damage to the product. Do not proceed beyond a caution until the indicated conditions are fully understood and met.

### **Disclaimer**

Software available for this product works with **Windows XP®**, **Windows 7®** and **Windows 10®**

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## TABLE OF CONTENTS

<b>1. GENERAL DESCRIPTION.....</b>	<b>6</b>	CHANNEL – TRIGGER AND GATE SCREEN ....	42
<b>2. FRONT AND REAR PANELS.....</b>	<b>7</b>	CHANNEL – TRAIN SCREEN.....	44
FRONT PANEL .....	7	CHANNEL – PULSE SCREEN.....	45
REAR PANEL .....	9	CHANNEL – AMPLITUDE SCREEN.....	46
<b>3. FUNCTIONAL OVERVIEW, DIAGRAMS, AND DEFINITIONS .</b>	<b>11</b>	CHANNEL – STEPPED AMPLITUDE SCREEN ..	48
TIMING.....	11	CHANNEL – PAIRED PULSE SCREEN .....	49
TRIGGERING, GATING & COUNTING .....	12	PROGRAM SCREENS .....	50
OUTPUT .....	13	PROGRAM 1 SCREEN .....	50
OUTPUT - OFFSETS.....	14	SUMMARY SCREENS .....	51
STEPPED WAVEFORMS.....	14	SUMMARY - TRAIN SCREEN .....	51
PAIRED PULSE WAVEFORMS.....	15	SUMMARY - PULSE SCREEN .....	51
SUM OUT (COMBINATION) OUTPUTS .....	15	SUMMARY - AMPLITUDE SCREEN .....	52
<b>4. PC CONTROL SOFTWARE INSTALLATION.....</b>	<b>16</b>	SYSTEM CONTROL SCREENS.....	52
WINDOWS 10 .....	16	MAIN MENU SCREEN .....	52
<b>5. USING THE PC CONTROL SOFTWARE.....</b>	<b>23</b>	COMPUTER IN CONTROL SCREEN.....	53
USING THE CONTROL SOFTWARE.....	23	PROGRAM STORAGE SCREENS .....	54
<b>6. INSTRUMENT OPERATION WITH PC SOFTWARE .....</b>	<b>25</b>	SETUP – LCD SETTINGS SCREEN .....	55
INITIAL POWER-UP .....	25	SETUP – CALIBRATE LCD SCREEN .....	56
PC PROGRAM MAIN CONTROLS.....	28	SETUP – START UP SCREEN .....	57
<b>7. TEST WAVEFORM EXAMPLES .....</b>	<b>33</b>	SETUP – ABOUT SCREEN .....	57
MONOPHASIC WAVEFORM.....	34	<b>9. SPECIFICATIONS.....</b>	<b>58</b>
BIPHASIC WAVEFORM .....	35	<b>10. WARRANTY .....</b>	<b>59</b>
STEPPED WAVEFORM.....	36		
PAIRED WAVEFORM.....	37		
SUM OUT (COMBINATION) WAVEFORM.....	38		
<b>8. INSTRUMENT OPERATION VIA FRONT PANEL TOUCHSCREEN .</b>	<b>39</b>		
HOME SCREEN.....	39		
CHANNEL SCREENS .....	40		
CHANNEL – TYPE SCREEN .....	40		

## LIST OF TABLES AND FIGURES

Figure 1. Power switch .....	7	Figure 35. Toolbar .....	40
Figure 2. Touch Screen Display.....	7	Figure 36. Channel - Train Screen.....	40
Figure 3. Front Panel Trigger Inputs and Gate Inputs.....	8	Figure 37. Channel – Trigger and Gate Screen.....	42
Figure 4. Channel Connections.....	8	Figure 38. Channel – Train Screen .....	44
Figure 5. Ground Connector .....	8	Figure 39. Numerical Time Entry Screen .....	44
Figure 6. Channel Specific Trigger.....	9	Figure 40. Channel – Pulse Screen .....	45
Figure 7. SIU Input .....	9	Figure 41. Channel – Amplitude Screen, Biphasic Pulse.....	46
Figure 8. USB Connector.....	9	Figure 42. Amplitude Screen, Asymmetric Pulse.....	46
Figure 9. Global Gate.....	10	Figure 43. Numerical Amplitude Entry Screen .....	47
Figure 10. AC Power Input / Line Switch .....	10	Figure 44. Channel – Amplitude Screen, Stepped Pulse.....	48
Figure 11. Timing Diagram .....	11	Figure 45. Channel – Amplitude Screen, Paired Pulse.....	49
Figure 12. Triggering and Gating .....	12	Figure 46. Program 1 Screen .....	50
Figure 13. Basic Outputs.....	13	Figure 47. Summary - Train Screen.....	51
Figure 14. Output Offsets .....	14	Figure 48. Summary - Pulse Screen.....	51
Figure 15. Stepped Waveforms.....	14	Figure 49. Summary – Amplitude Screen.....	52
Figure 16. Paired Pulses.....	15	Figure 50. Main Menu Screen .....	52
Figure 17. Combination Outputs.....	15	Figure 51. Computer in Control Screen.....	53
Figure 18. PC Software - Unconnected .....	24	Figure 52. Program List Screen .....	54
Figure 19. Boot Screen .....	25	Figure 53. Program Name Keyboard Screen ..	54
Figure 20. Calibration Screens.....	25	Figure 54. Save Screen .....	55
Figure 21. Main Menu .....	26	Figure 55. Setup- LCD Settings Screen.....	55
Figure 22. PC Software - Connected .....	27	Figure 56. Setup – Calibrate LCD Screen .....	56
Figure 23. Instrument Screen when Computer is in Control .....	28	Figure 57. Setup – Start Up Screen.....	57
Figure 24. PC Software – Load from 3800.....	29	Figure 58. Setup – Start Up Screen.....	57
Figure 25. PC Software – Load from Instrument Flash.....	30		
Figure 26. PC Software – Load from Instrument Flash.....	31	Table 1. Timing Resolution .....	41
Figure 27. PC Software – Running Program ..	32		
Figure 28. Model 3800 Examples.ams Test Program.....	33		
Figure 29. Examples.ams Test Program – Channel 2 Monophasic .....	34		
Figure 30. Examples.ams Test Program – Channel 3 Biphasic .....	35		
Figure 31. Examples.ams Test Program – Channel 4 Stepped .....	36		
Figure 32. Examples.ams Test Program – Channel 5 Paired Pulses.....	37		
Figure 33. Examples.ams Test Program – Channel 8 Sum Out Waveforms .....	38		
Figure 34. Home Screen .....	39		



## 1. General Description

The *Model 3800 MultiStim* is a multichannel programmable stimulator designed for a wide variety of applications. It is highly flexible, being capable of simultaneously delivering up to 8 different series of pulse trains comprised of monophasic or biphasic pulses, stepped pulses, or paired pulses, or combinations thereof by using the instrument's 8 programmable stimulus channels.

Timing on each channel may be initiated manually or upon receiving a trigger signal from any of the MultiStim's other channels, the supplied PC compatible software, or from a separate instrument or computer. Complicated stimulus trains can be generated by summing any channel's defined output with any number of the other channels' output trains. All channels can be gated using either internal or external commands. Sync pulses are available for use by other instruments and can track either train duration or pulse width.

The *Model 3800 MultiStim 8-channel Programmable Stimulator* can produce pulses ranging in duration from one microsecond to 12 days. Amplitudes can be set to range from  $-10V$  to  $10V$ , with  $1mV$  resolution. When combined with the Model 3820 External SIU, the voltage pulse can be scaled and converted into constant current, with output ranges of up to  $10mA$  on each SIU channel.

The *Model 3800 MultiStim 8-channel Programmable Stimulator* is controlled by a front panel touch screen or a easy to use software program. Program parameters can be stored onboard the instrument for later recall, or can be stored online.

**The Model 3800 MultiStim 8-channel Programmable Stimulator is not approved for clinical or operating room experiments in human subjects.**

## 2. Front and Rear Panels

This chapter describes the front and rear panel controls and connectors on the Model 3800. Chapter 8 describes the individual screens available on the touch-screen LCD interface.

When you receive your Model 3800, confirm that everything in the packing list is included. Make sure there are no obvious signs of internal damage, such as rattling. Pick up the instrument and tilt in gently from side to side, and listen for anything that might be loose. If you hear any suspicious noises, contact A-M Systems immediately.

### Front Panel

#### Power

This switch determines if the Model 3800 is powered to operate, or to recharge optional Model 3820 Stimulus isolation units. If the Rear Panel Mains Power switch is in the ON position, when this front panel switch is in the ON position, the front panel LCD screen will illuminate, and the LEDs just below each channel's designator will turn to red, green, or blue, depending on the status of the instrument's start-up program. If the Rear Panel Power switch is in the ON position, when this front panel switch is in the OFF position, the front panel LCD screen will dim, the LEDs will turn off, and power will be supplied to any attached Model 3820 SIUs for battery charging.

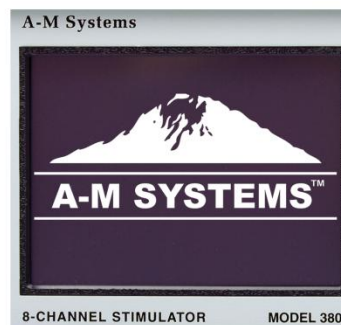
**Figure 1. Power switch**



#### Display

The liquid crystal display (LCD) on the Model 3800 is a touch-screen interface whose input determines the settings for all of the Model 3800 functions. See Ch 8 for screen captures of individual screens displayed during operation

**Figure 2. Touch Screen Display**



## TRIG

Each channel can be linked via settings on the touch screen or the PC program to any of the three front panel triggers (A, B, C). Presentation of a 5V pulse to the BNC connector will initiate timing on all of the linked channels. Trigger rules of operation are presented in Chapter 3

## GATE

Each channel can be linked via settings on the touch screen or the PC program to any of the three front panel gates (A, B, C). Presentation of a ground level signal (0 volts) to the BNC connector will result in a 0 V signal output of the gated channel when the gate is held low. Timing will continue, but the output will be disabled. Gate rules of operation are presented in Chapter 3

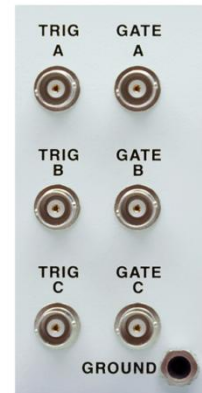
## CHANNEL

Each channel has 3 front panel BNCs and one LED. SYNC OUT provides a TTL level pulse coincident with either train duration or pulse duration (selectable on a per channel basis on the channel's programming menu). SIG OUT is the voltage output of the pulse train defined for that channel. SUM OUT is the summed voltage output for that channel as defined by the channel summing selection matrix. Rules for trigger/gating the SUM OUT signal are describe in Chapter 3. The LED below each channel indicator can either be RED, BLUE, GREEN, or BLANK. RED indicates there is a timing conflict in the program definition that must be corrected. If an optional SIU is attached to the channel, and the unit cannot provide the current/voltage requested because of a conflict of Ohm's law, then the LED will illuminate red. BLUE indicates that a stimulus pulse is being delivered. GREEN indicates that the channel is on and awaiting a trigger to initiate timing. BLANK indicates the channel if off.

## GROUND CONNECTOR

This banana jack is the stimulator's chassis ground, and is directly connected to Earth (ground) via the power cord.

**Figure 3. Front Panel Trigger Inputs and Gate Inputs**



**Figure 4. Channel Connections**

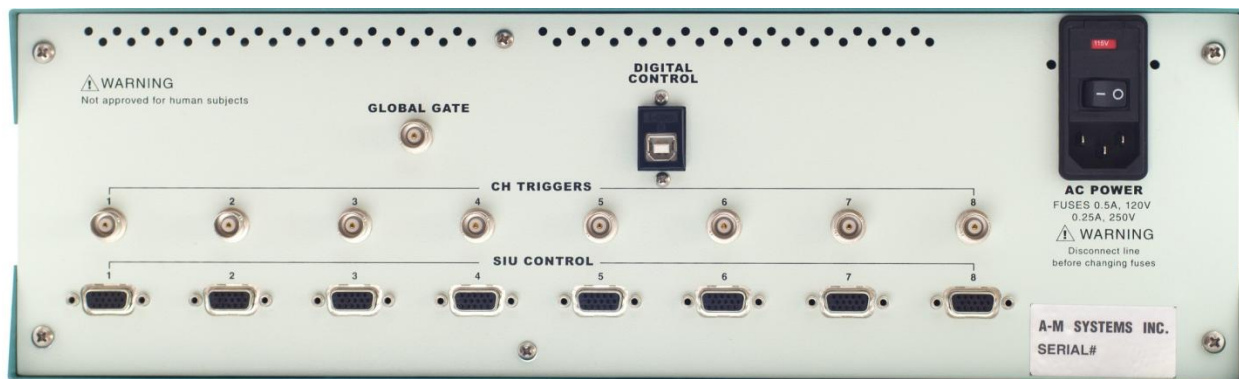


**Figure 5. Ground Connector**





## Rear Panel



### Channel Specific Triggers

Each channel has a rear panel BNC that is a specific trigger for that channel only. Presentation of a 5V pulse to the BNC connector will initiate timing on the channel of the same number. Trigger rules of operation are presented in Chapter 3

Figure 6. Channel Specific Trigger



### SIU Input

This D-Sub 15 pin connector attaches to the cables of A-M Systems Stimulus Isolation Units Model 3820 (Purchased separately). *Note:* It is not wired as a “video” connector commonly found on computers.

Figure 7. SIU Input



### USB Connector

This connector enables a personal computer running the supplied Windows® operating system compatible control program to control the Model 3800.

Figure 8. USB Connector



## Global Gate

Presentation of a ground signal level (0 volts) to this BNC will end all timing of all channels on the Model 3800, and all outputs will return to 0 Volts. Removal of the ground signal level will enable the instrument, and all channels will return to their normal state awaiting next trigger inputs.

**Figure 9. Global Gate**



## WARNING

### AC Power Input

This instrument has a terminal for protective grounding. Before applying power, verify that the correct safety precautions are taken. The position of the fuse box drawer determines the appropriate line voltage (110 or 220) the instrument is configured to operate on.

When this switch is in the OFF position, no power is supplied to the base unit. When this switch is in the ON position, power is supplied to the base unit or to the battery charging circuitry of any connected Model 3820 SIUs, depending on the position of the front panel Power Switch.

Do not operate the instrument with its covers removed. Replace fuse only with specified type. Before turning on the instrument, you must connect the protective earth terminal of the instrument to the protective earth conductor of the (mains) power cord. The mains plug must only be inserted in a socket outlet with a protective earth contact.

**Figure 10. AC Power Input / Line Switch**



### 3. Functional Overview, Diagrams, and Definitions

This section will present an overview of instrument function, including timing diagrams and definitions. Detailed information about instrument functions, settings, and programming follow later in the manual.

#### Timing

Each channel of the Model 3800 Multistim Programmable Stimulus Generator can create trains of voltage pulses varying in duration, frequency, and pattern.

A train consists of a repeating sequence of pulse events.

Following a trigger input (TR), there are 3 defined time periods:

- 1) Train delay (TD): duration from trigger input to onset of first pulse
- 2) Train width (TW): epoch beginning at end of train delay
- 3) Train period (TP): interval between onset of successive train delay periods

The number of trains delivered per TRIGGER is determined by Train Number (TN)

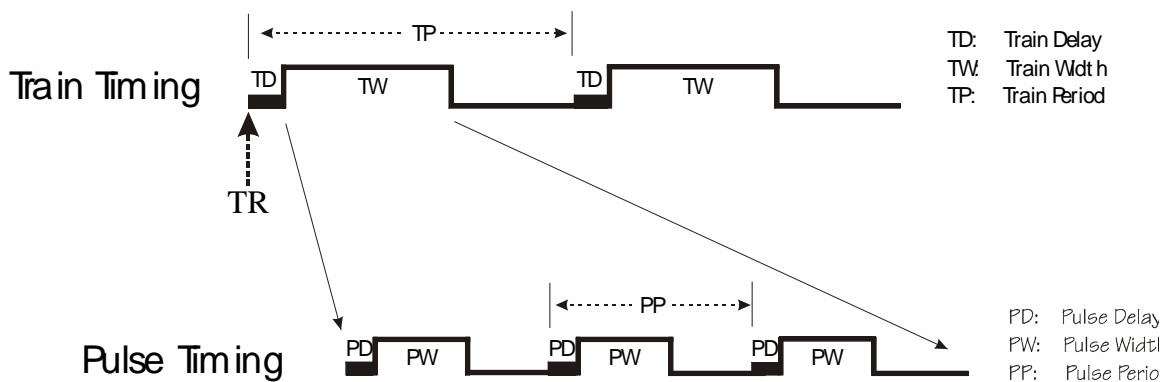
Simultaneous with the onset of the Train Width (TW) period is the onset of Pulse Timing.

The entire sequence of pulses is completed within one TW period.

Similar to a train, there are 3 defined time periods in pulse timing, where the end of one begins the next:

- 1) Pulse delay (PD): duration from end of Train Delay to onset of first pulse
- 2) Pulse width (PW): duration of each phase of a pulse
- 3) Pulse period (PP): interval between onset of successive pulse delay periods

**Figure 11. Timing Diagram**



## Triggering, Gating & Counting

The onset of train timing requires a TRIGGER input. Triggers can be internally or externally generated.

Examples of internal triggers are:

- 1) The leading edge of Event Duration Output Pulses from a different channel
- 2) Free Run (The train sequence is initiated upon setting the channel to "on", and immediately upon completion of the train sequence, a new trigger is generated and the sequence repeats. This cycles indefinitely until the channel or the master enable is turned off).
- 3) Touch Screen-initiated Single Run triggers, which initiate a single train timing sequence upon button pressing.

Examples of external triggers are TTL inputs to front or rear panel BNC's, that can initiate train timing either on their leading or their trailing edge, or the use of the PC software control program.

NOTE: Triggers that arrive during active train sequence timing are ignored (trigger #5 below)

GATING. The operation of a channel can be gated, such that if the GATE signal is low, the channel will not respond to any trigger inputs, and no outputs will be generated (all outputs will be set to ground).

Some examples are diagramed below :

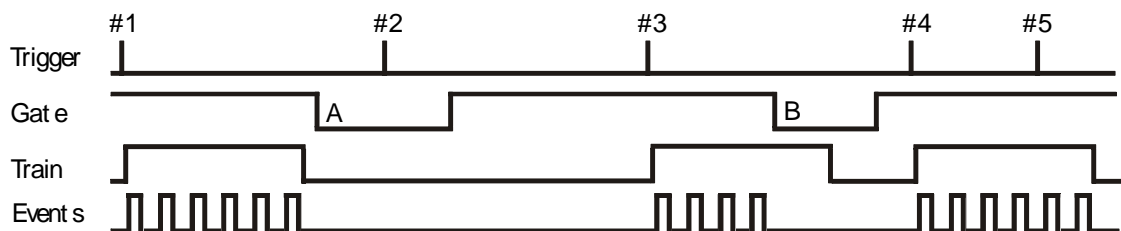
Gate occurrence A prevented train generation in response to trigger #2

Gate occurrence B terminated output generation during train triggered by trigger #3.

### COUNTING

The user determines the number of train timing sequences to be delivered by setting the Train Number. Once the defined number of train sequences has been completed, train timing generation ceases and the channel can accept new trigger input.

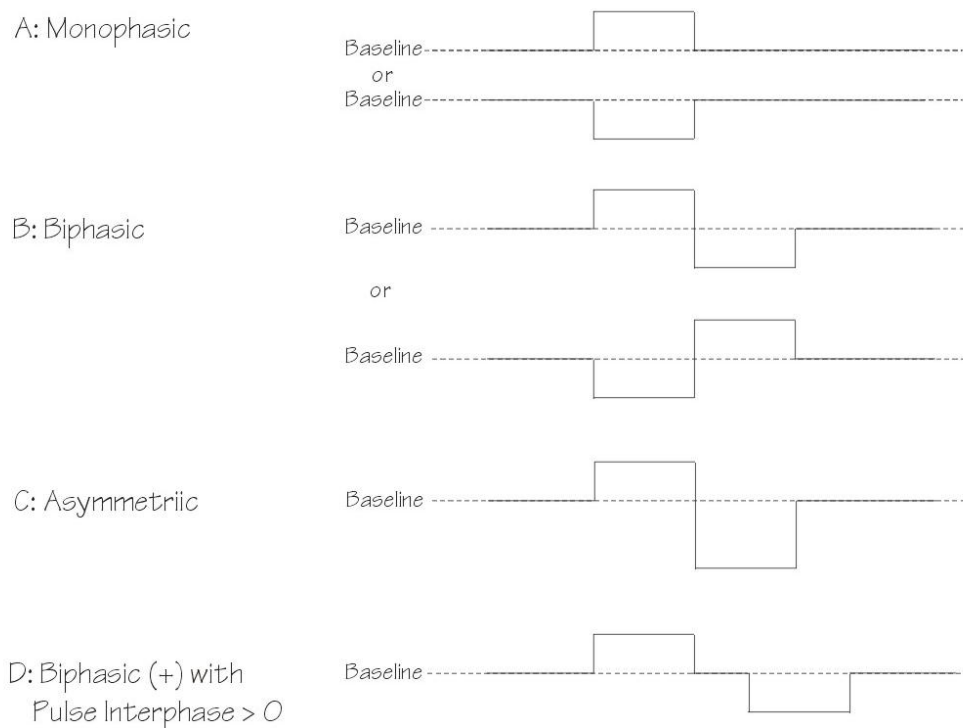
**Figure 12. Triggering and Gating**



## Output

Pulses generated by each channel can be monophasic, biphasic, or asymmetric. Monophasic pulses (Example A) have durations equal to the Pulse Width (PW) duration, and can either be positive or negative. Biphasic pulses (Example B) have two timing phases that are equal in amplitude but opposite in polarity. The amplitude of first phase can be positive or negative, and the second phase will be opposite in polarity. The duration of each phase is equal to Pulse Width (PW) duration. Asymmetric Pulses (Example C) are similar to the Biphasic pulse, except that the amplitudes of the two phases do not need to be equal in magnitude. The two phases of biphasic and asymmetric pulses can be separated by a Pulse Interphase (PI) as illustrated in Example D. See Chapter 7 for real examples.

**Figure 13. Basic Outputs**

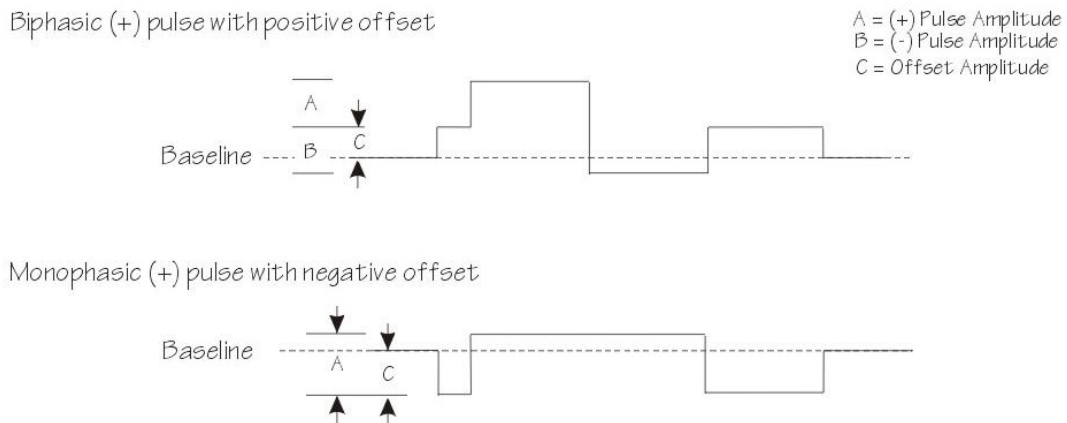


Note that the heading “Asymmetric” is only used on the Model 3800 touchscreen interface, in order to enable simple one-button adjustment of stimulus amplitudes. When using the PC software program, any “Biphasic” stimulus can be made “Asymmetric” simply by entering the pulse amplitudes desired. For those who want symmetric pulse amplitudes, checking the box adjacent to the pulse amplitudes will gray out Pulse 2 amplitude, and force the amplitude of the second pulse to be equal (and determined by) the Pulse 1 amplitude data value.

## Output - Offsets

Offsets can be either positive or negative. Pulse magnitudes are referenced to the offset (baseline) value, rather than 0V. Offsets are applied for the duration of the Train Width period.

**Figure 14. Output Offsets**



## Stepped Waveforms

The amplitude of the output can be changed by a fixed amount every train. The amount of change can be either positive or negative. The initial amplitude is determined by AMPLITUDE START (or AS). The change (step) in amplitude is determined by AMPLITUDE CHANGE (or AC) and can be positive or negative. See Chapter 7 for a real example.

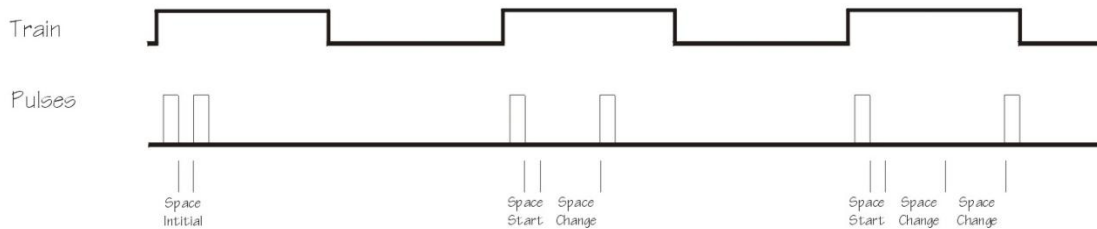
**Figure 15. Stepped Waveforms**



## Paired Pulse Waveforms

The timing of pairs of stimuli of the output can be changed by a fixed amount every train. The amount of change can either be positive or negative. The initial interval between the pair of pulses is determined by SPACE START. *NOTE:* This is defined as the time between the offset of the first pulse and the onset of its pair. The change (step) in timing is determined by SPACE CHANGE & SPACE POLARITY. Intervals can increase or decrease. See Chapter 7 for an example.

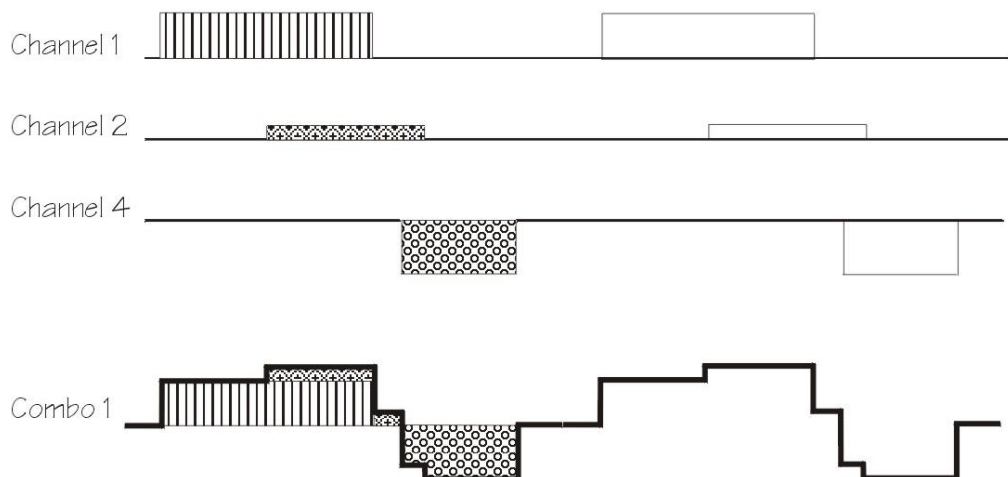
**Figure 16. Paired Pulses**



## Sum Out (Combination) Outputs

Each channel has a SUM OUT BNC, which sums the outputs of multiple channels into a single output. Suppose Channels 1, 2, and 4 were selected to be summed on Sum Out Output 1. The output signal present at the SUM OUT BNC for channel 1 would be pictured below. *(The patterns in the first set of stimuli on each channel are to understand how the signals would be summed in the combo output)* Note: Triggering and gating of the Sum Out signal is determined by that channel's triggering and gating settings: i.e., Channel 3 Sum Out is controlled by Chan 3 trigger and gate settings. If the channel is off, then its Sum Out signal is off, and its contribution to other channel Sum Out signals is disabled. See Chapter 7 for a real example.

**Figure 17. Combination Outputs**



## 4. PC Control Software Installation

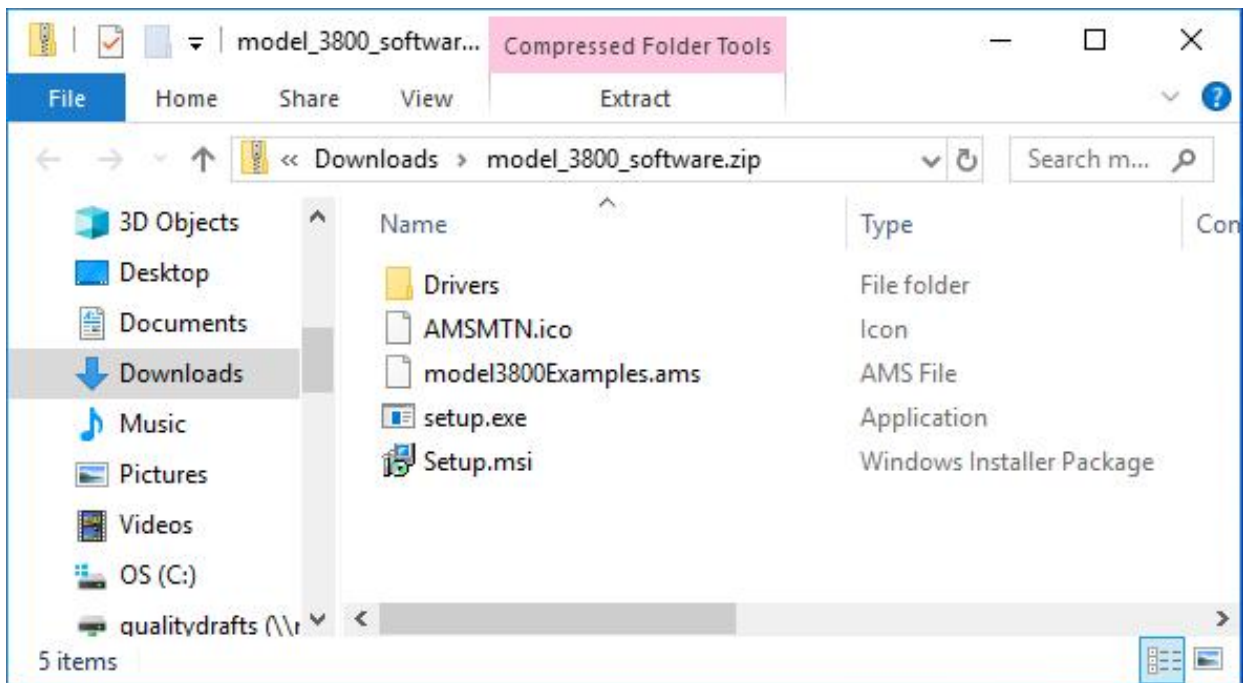
The Model 3800 can be controlled by Windows compatible software that is available for download at [www.a-msystems.com](http://www.a-msystems.com). The downloadable control software runs on Windows® 10, 7, and, Windows® XP. The section that follows covers installation procedures for Windows 10. If you require instructions for previous versions of Windows, please contact A-M Systems.

This software controls all features of the amplifier via a USB port. If you plan to control your model 3800 using the supplied software, continue on with this chapter. If you plan to solely use the touch screen interface, you may skip to Chapter 8.

### Windows 10

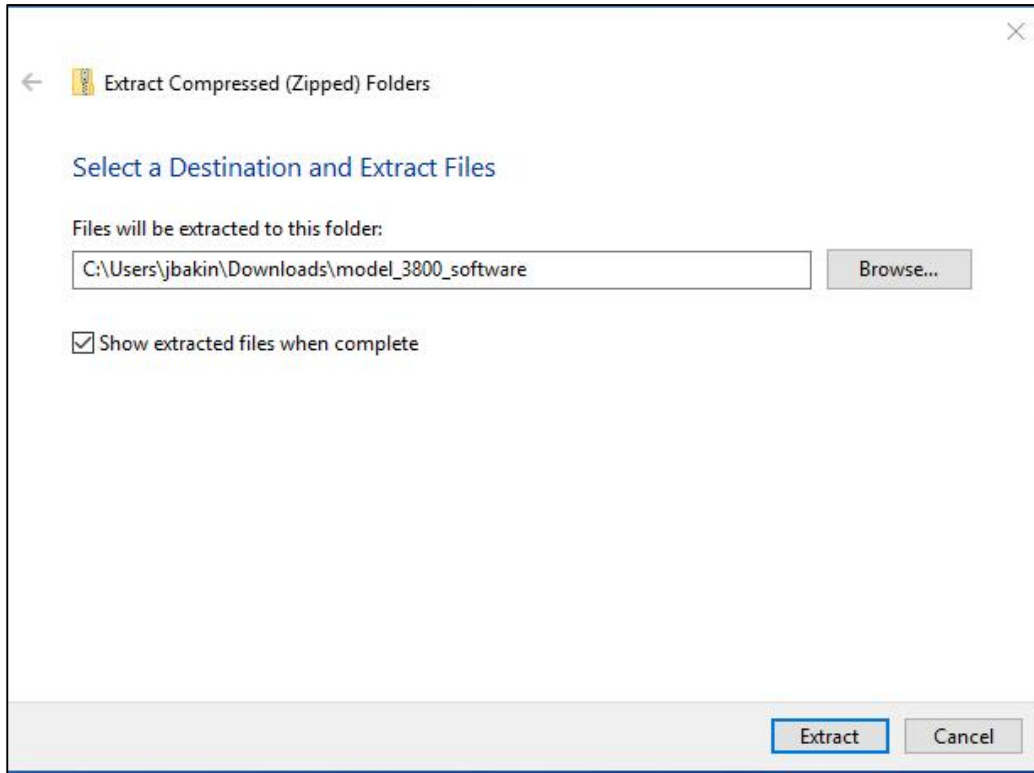
Download the most recent version of Model 3800 control software from [www.a-msystems.com](http://www.a-msystems.com). The software is located on the Model 3800 webpage.

Open the compressed file.

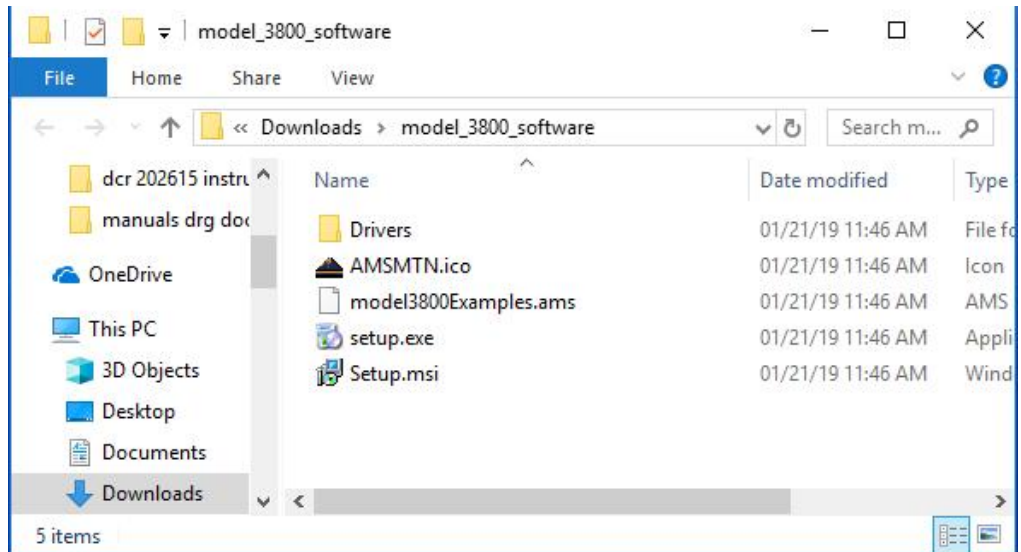




Extract the files to a new folder:



Once extracted, double click to run the “Setup.exe” file.



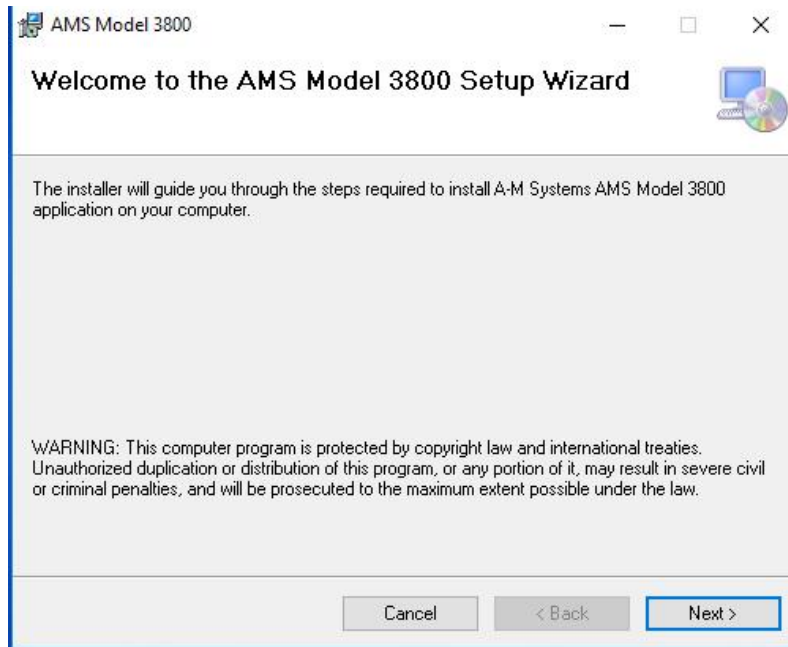
You might see a warning dialog from the Windows 10 operating system.



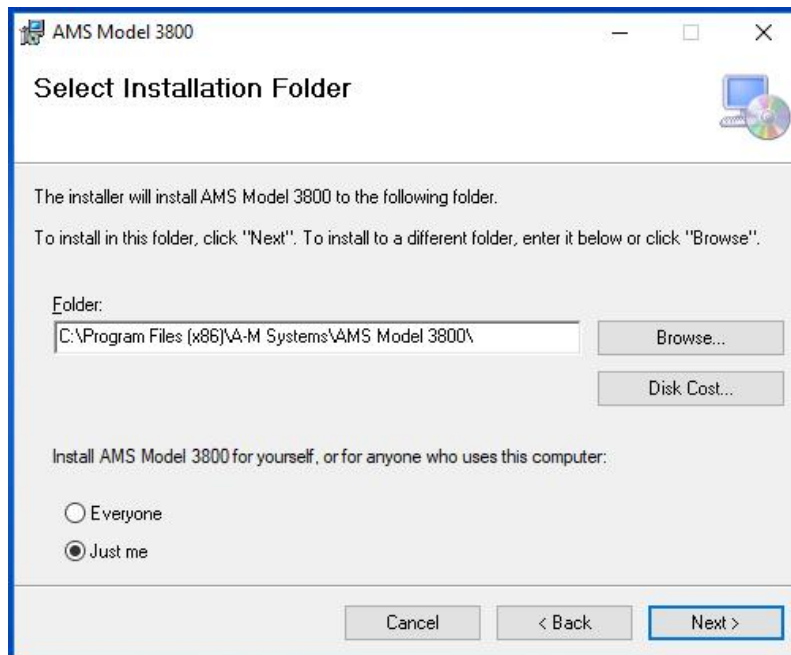
Click on "More Info" to expand the dialog box.



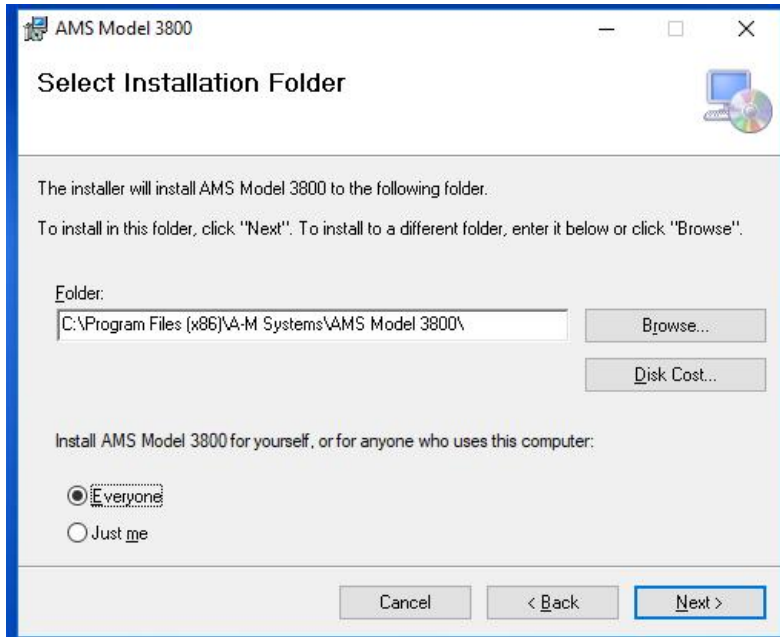
Click on “Run Anyway” to continue the installation. The Model 3800 installation dialog should appear:



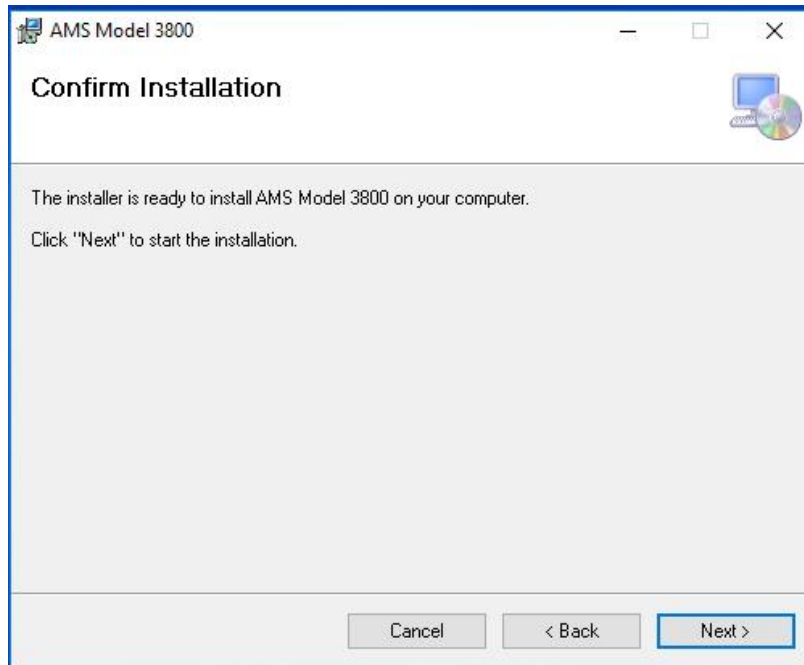
Click on next to continue installation.



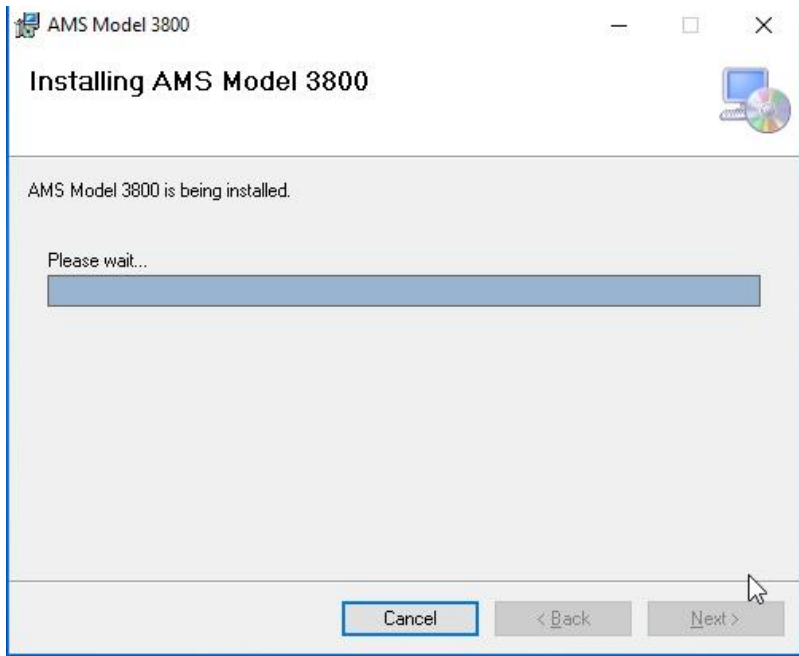
A dialog box suggesting the file location will open. A question asks for who should be able to use the pc control software. Select “Everyone” and click “Next”



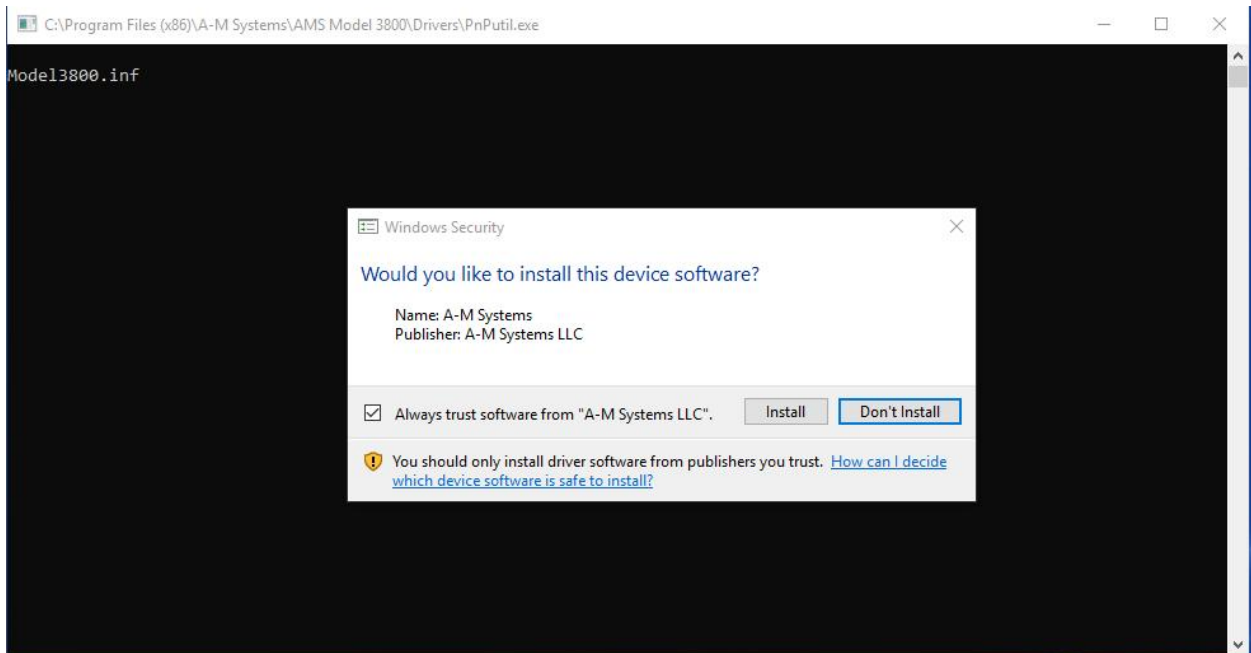
Confirm that you want to install the software by clicking “Next.”



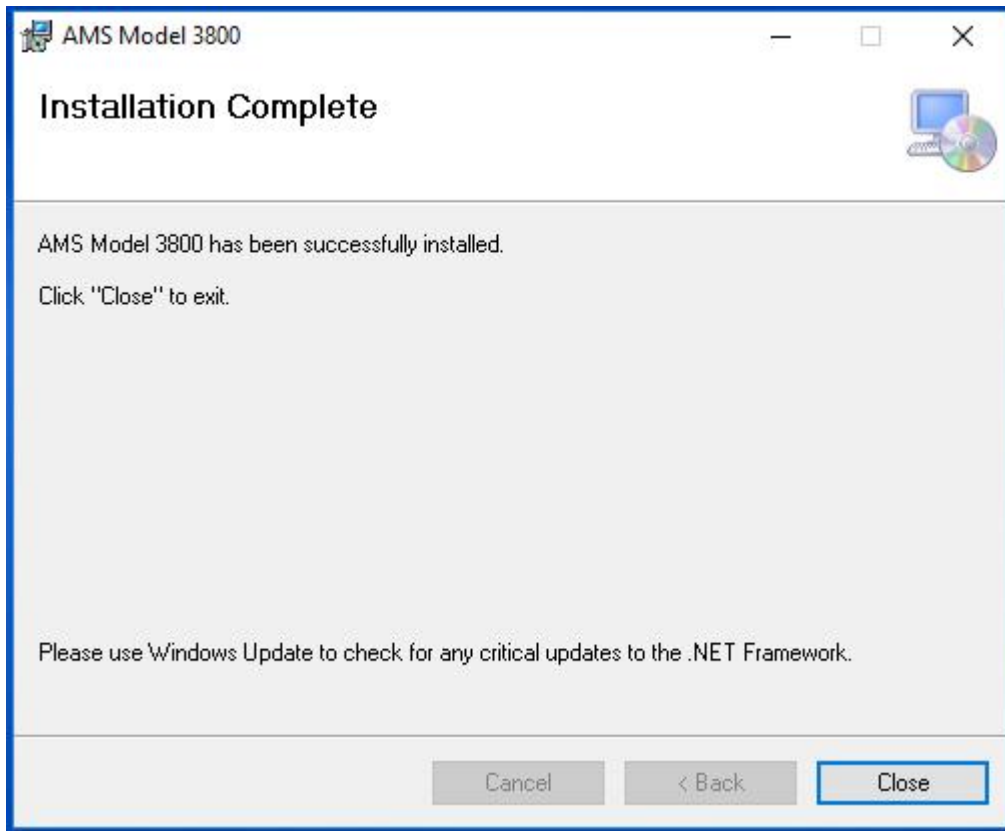
The installer will begin the process:



Windows Security might display an additional warning box. Select "Install"



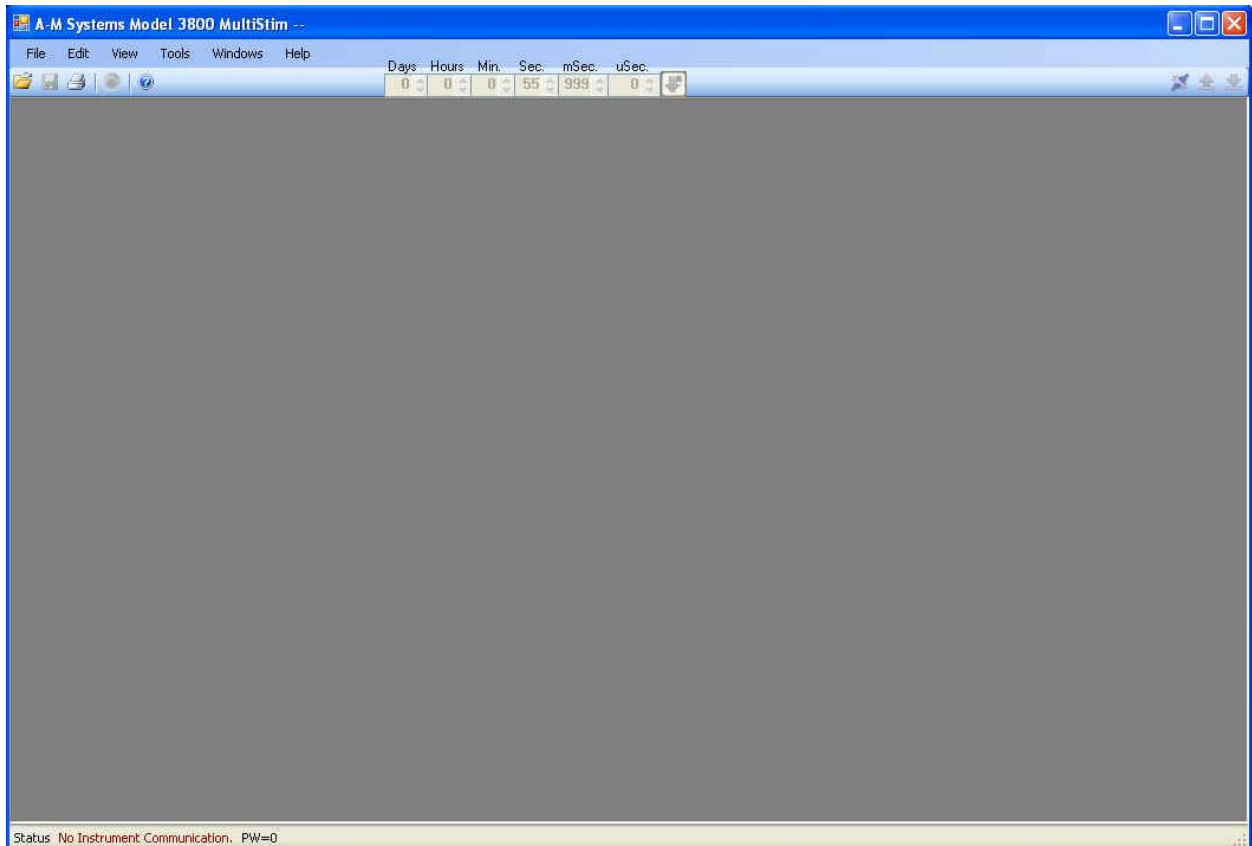
Once installation is complete, a final dialog box will be displayed:



## 5. Using the PC Control Software

### *Using the Control Software*

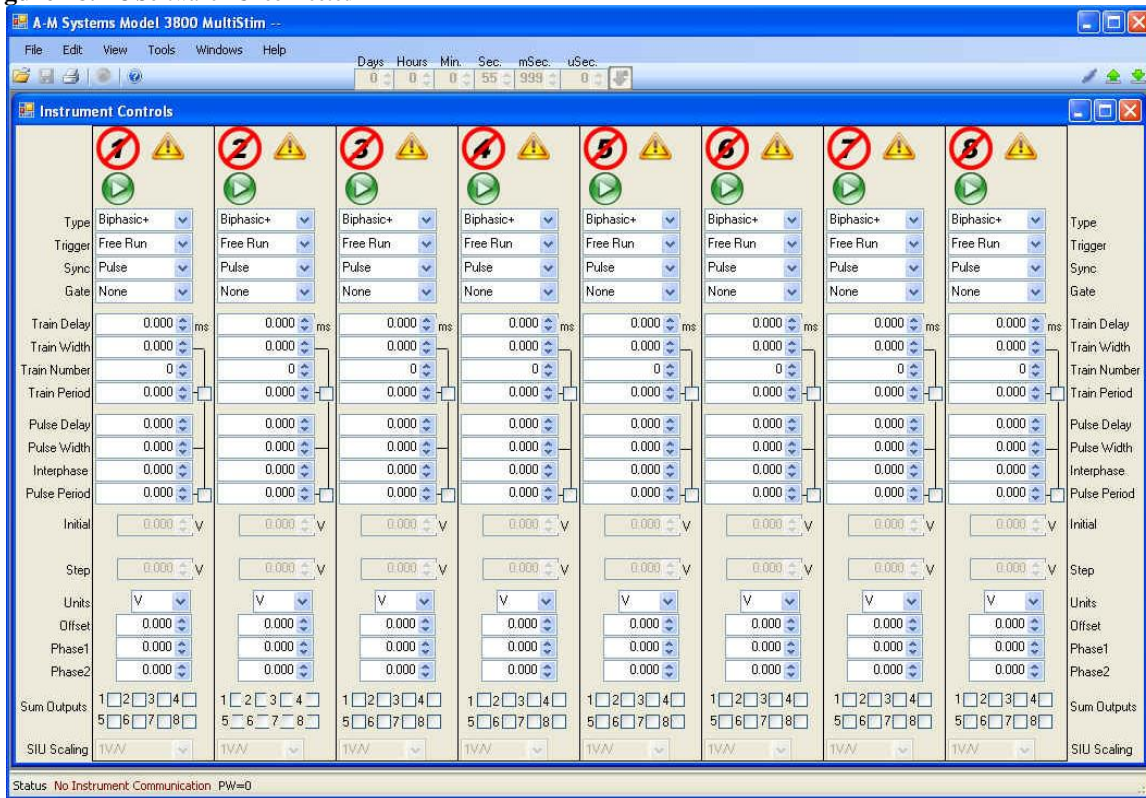
After the program has been installed, you can run it from the Start Menu by selecting Programs -> A-M Systems -> Model 3800.



Upon initial opening, the window will be blank.

Select File Open, and New.

**Figure 18. PC Software - Unconnected**



Note that at this point, in the “Status” area at the bottom of the window, the PC program is indicating “No Instrument Connection”

In the next section we will explain how to connect your instrument and go through the example waveforms.



## 6. Instrument Operation With PC Software

### *Initial Power-Up*

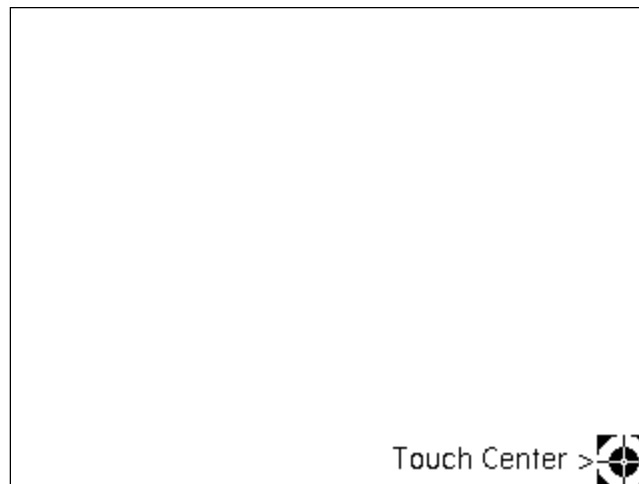
After unpacking your instrument and installing the provided software, turn the instrument on using the front panel power switch. The touch-screen LCD should illuminate and the A-M Systems logo should be displayed briefly as the on-board software loads.

**Figure 19. Boot Screen**



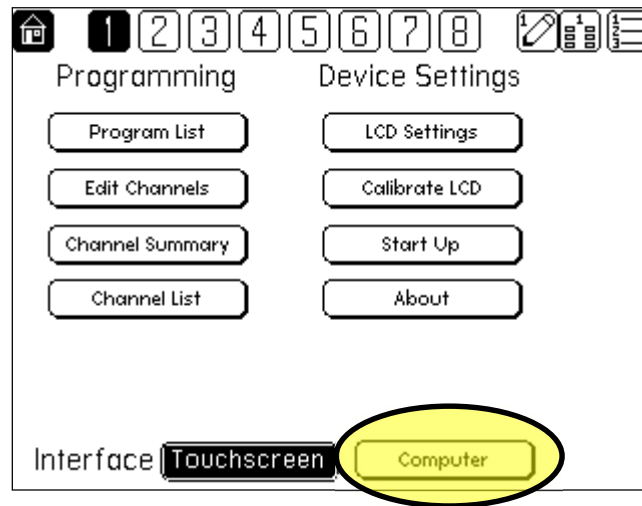
After the initial software loads, the Calibrate Screen Process will begin. By touching the indicated targets, the software responsible for tracking user input will determine the user's local pressure maxima when they press the screen, and will adjust subsequent target hot areas accordingly, thereby increasing the accuracy of the screen for that particular user.

**Figure 20. Calibration Screens**



After completing the calibration process, the unit will display the MAIN MENU. For purposes of the ensuing discussion, put the computer in control by **waiting at least 10 seconds** before selecting the COMPUTER button at the bottom of the screen in the INTERFACE section. If you want to control the instrument with the front panel touchscreen, please skip to Chapter 8, page 52

**Figure 21. Main Menu**



If the Model 3800 Front panel immediately returns to the HOME screen, wait at least 10 seconds before pushing the “Computer” button on the front panel.

On the PC, click on the “Connect” icon in the upper right, or go to “Tools\Connect to Instrument”

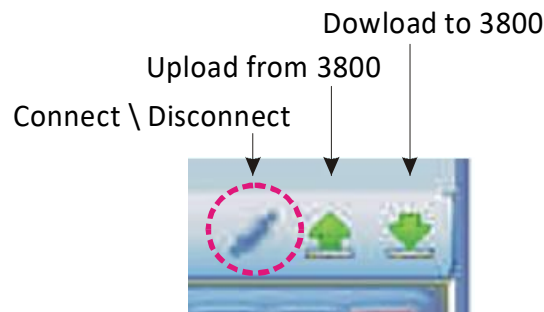
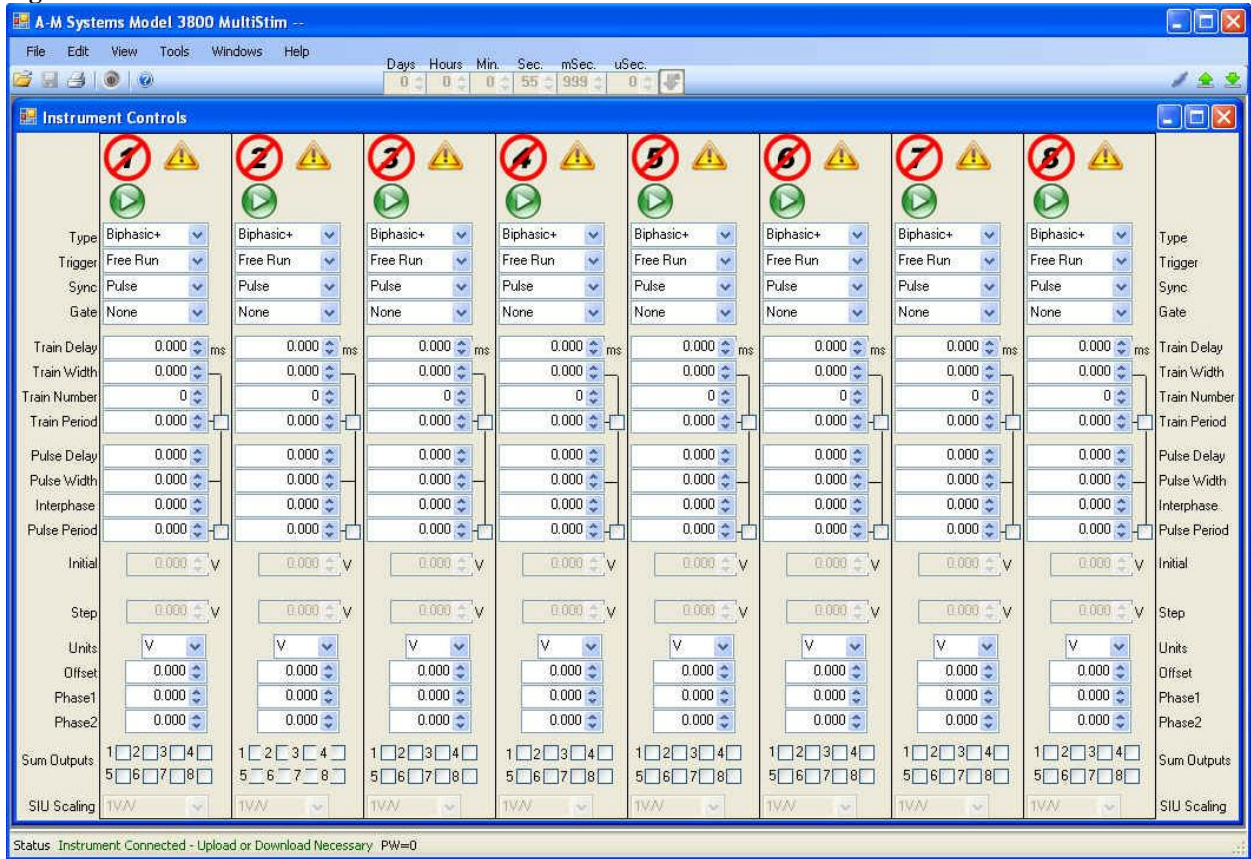
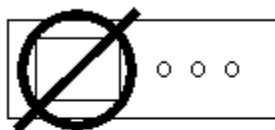


Figure 22. PC Software - Connected



At this point, note that the status has updated to “*Instrument Connected – Upload or Download as Necessary*”

**Figure 23. Instrument Screen when Computer is in Control**



This amplifier is currently under external computer control. To use the LCD again. Go to the computer and select set LCD in control

At this point, the display on the instrument will change to this display.

To return the control of the instrument to the front panel, go to “Tools \ Set LCD in control” or click on the disconnect icon in the upper right of the PC program.

### **PC Program Main Controls**

The Global Enable button must be pushed to activate timing (4<sup>th</sup> button from left at top of screen, next to the printer icon:



To turn a channel on, click on the Green play button. A red circle with a line through it indicates the channel is not timing. To pause timing on a channel, click on the tan Pause button.

To change timing parameters, click on the up/down arrows to scroll through values or click on the value itself to manually enter the new numbered value.

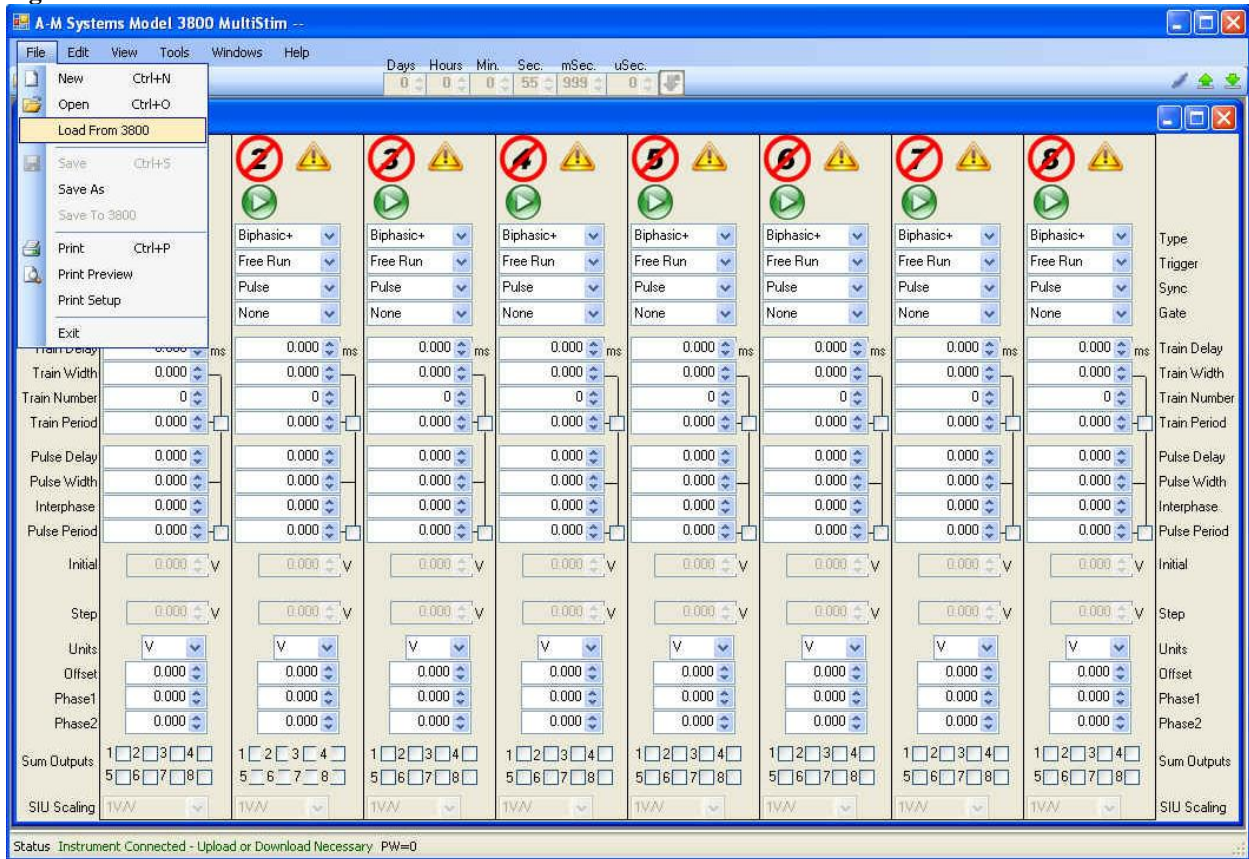
Error conditions will result in the appearance of an error indicator. Hovering over the indicator with the computer mouse will reveal the incorrect setting.

If the Trigger is set to MANUAL, a blue GO button will appear. Pressing the GO button will generate a trigger pulse.

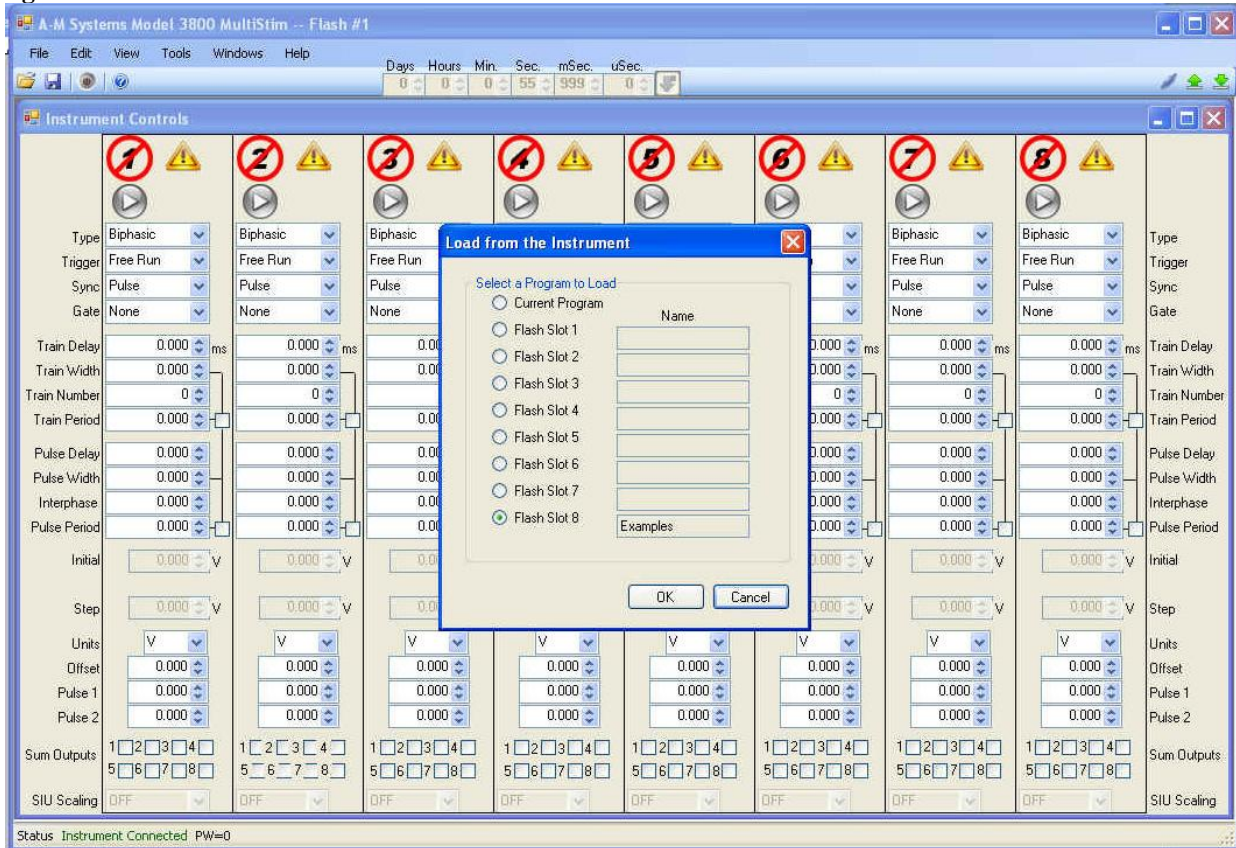
By clicking the boxes next to the train period and pulse period, 50% symmetrical cycles can be easily generated.

Programs can be loaded from the Model 3800 itself by following the instructions under “File>Load From 3800.” Up to 8 programs can be stored in the Model 3800 onboard memory. In addition, programs can be stored on your computer, and run by selecting “File>Open” and then downloading them to the instrument.

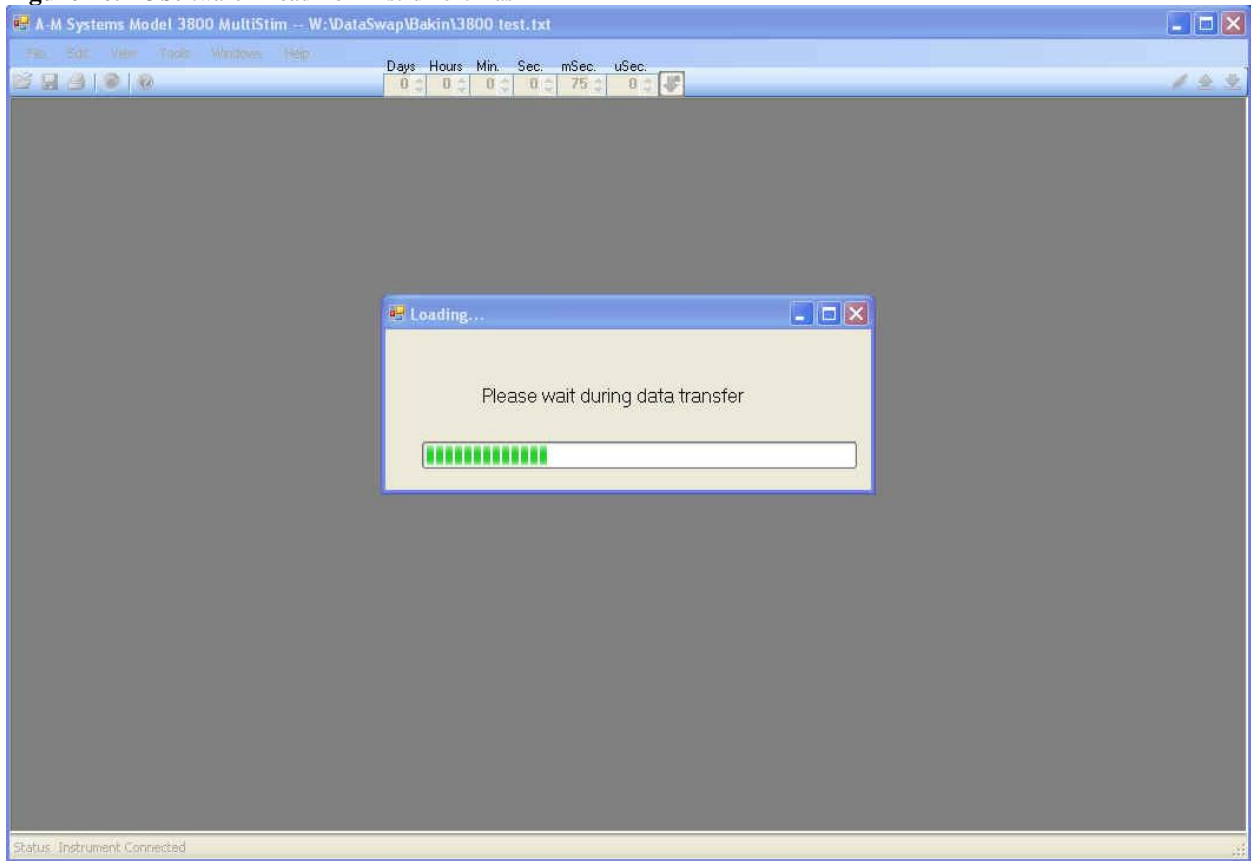
**Figure 24. PC Software – Load from 3800**



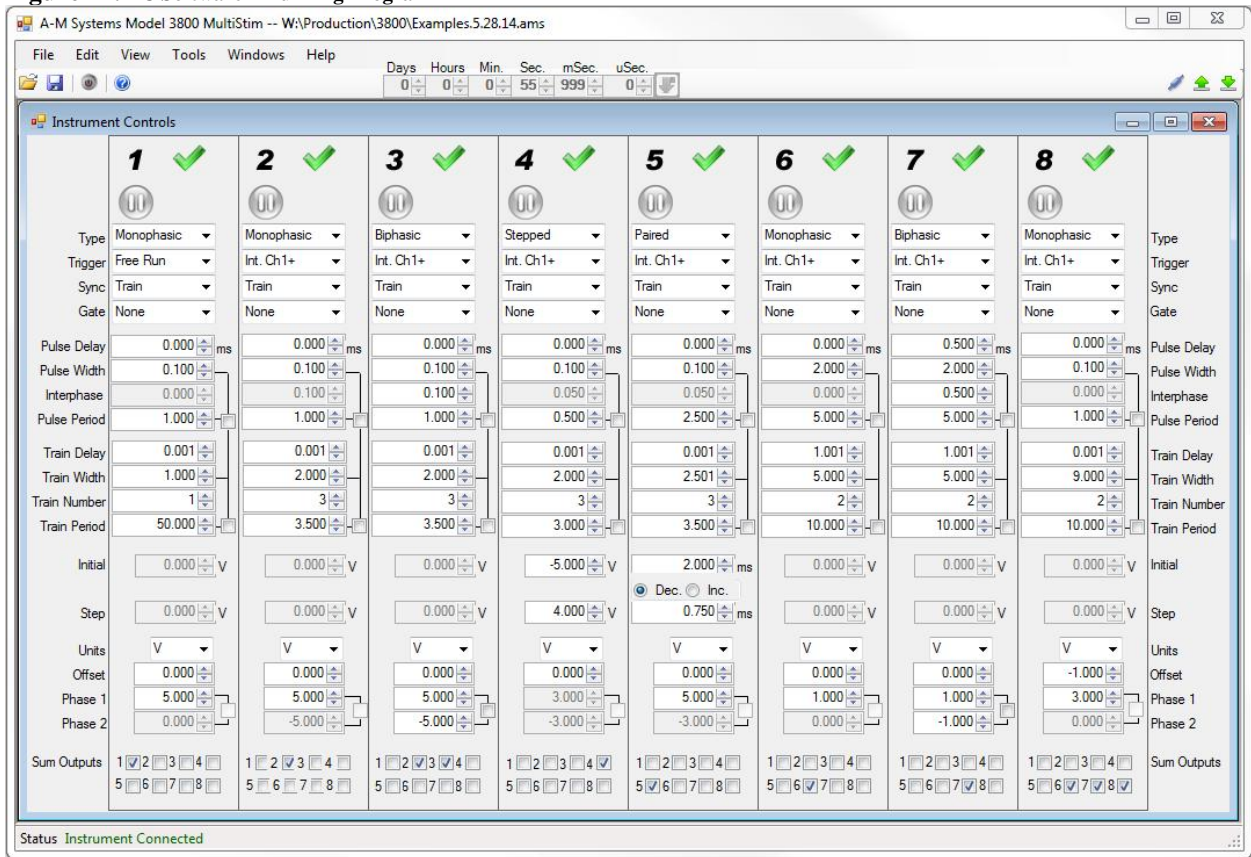
**Figure 25. PC Software – Load from Instrument Flash**



**Figure 26. PC Software – Load from Instrument Flash**



**Figure 27. PC Software – Running Program**



Properly defined channels will display a green arrow when they ready to run or when they are running.

Remember, the Global Enable button must be pushed to activate timing (4<sup>th</sup> button from left at top of screen, next to the printer icon):

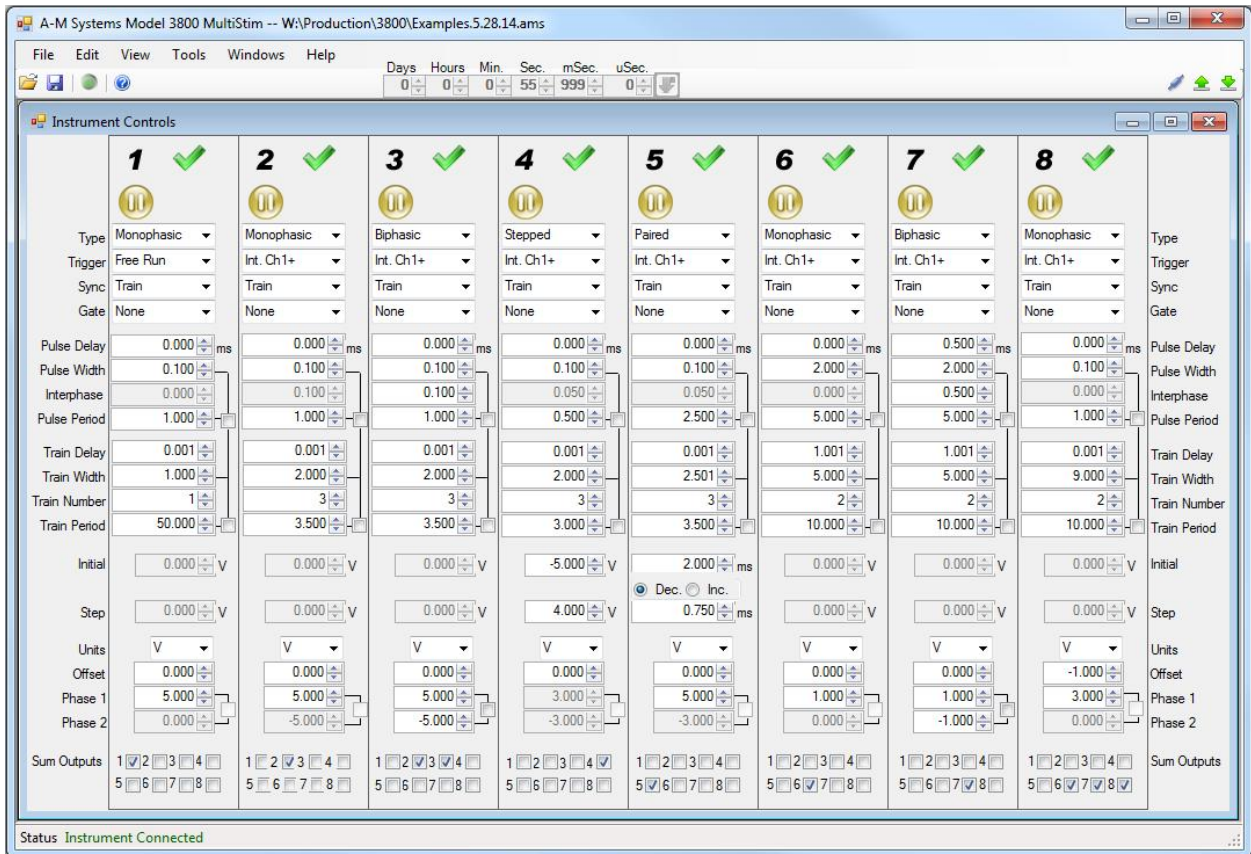




## 7. Test Waveform Examples

Load “Examples.5.28.14.ams” from the CD or from Flash Slot #8 (if it has not been overwritten).

**Figure 28. Model 3800 Examples.ams Test Program**



This file contains several test waveforms that you can use to verify basic performance of the model 3800.

## Monophasic Waveform

Configure your oscilloscope to trigger off of Channel 1 SYNC.

Connect Channel 2 SIG OUT to your oscilloscope channel 1 signal in.

Connect Channel 2 SYNC to your oscilloscope channel 2 signal in.

Set your oscilloscope channel gains to 5V/div and your scope timebase to 1ms/div.

Enable the Model 3800 by clicking on the global enable button:

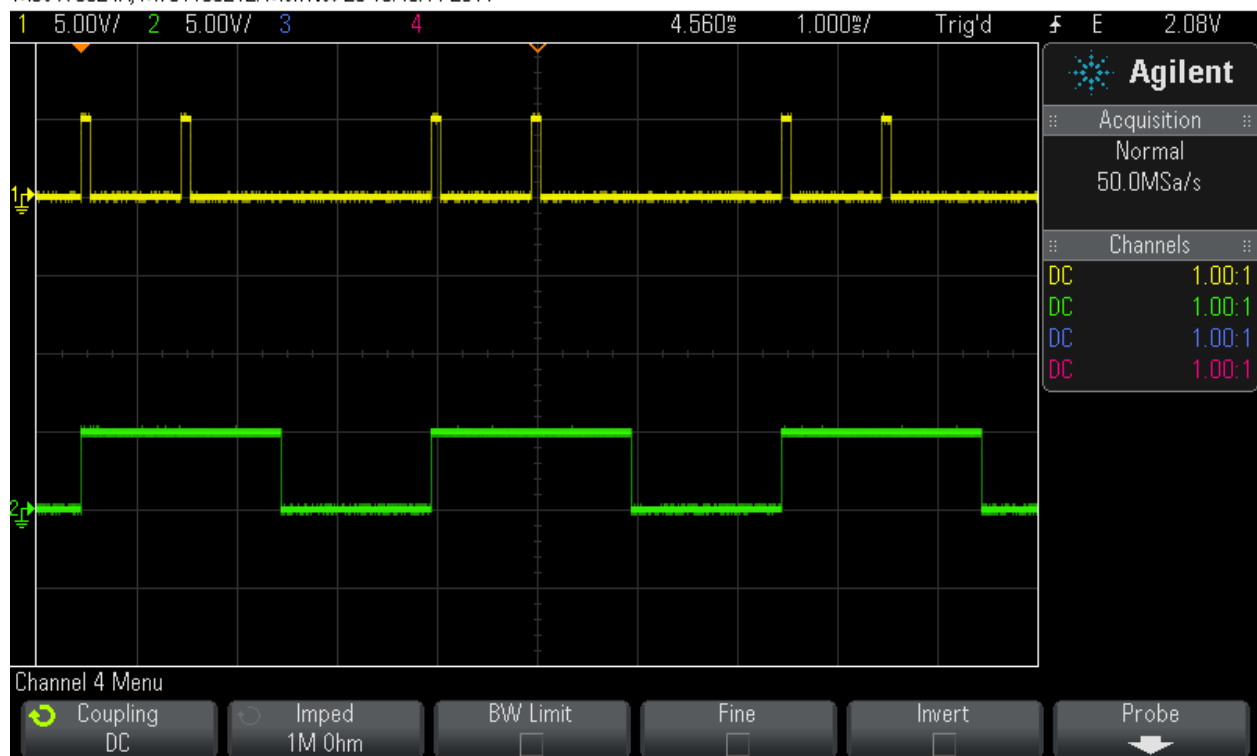


You should observe waveforms similar to the ones below, where the top trace is the output of Channel 2 SIG OUT and the lower trace is the output of Channel 2 SYNC.

In the PC Program for Channel 2, edit “Phase 1” to read -5.0V and you should see the polarity of the waveform invert.

**Figure 29. Examples.ams Test Program – Channel 2 Monophasic**

MS0-X 3024A, MY51136212: Mon Nov 28 10:46:11 2011



## Biphasic Waveform

Configure your oscilloscope to trigger off of Channel 1 SYNC.

Connect Channel 3 SIG OUT to your oscilloscope channel 1 signal in.

Connect Channel 3 SYNC to your oscilloscope channel 2 signal in.

Set your oscilloscope channel gains to 5V/div and your scope timebase to 1ms/div.

Enable the Model 3800 by clicking on the global enable button:

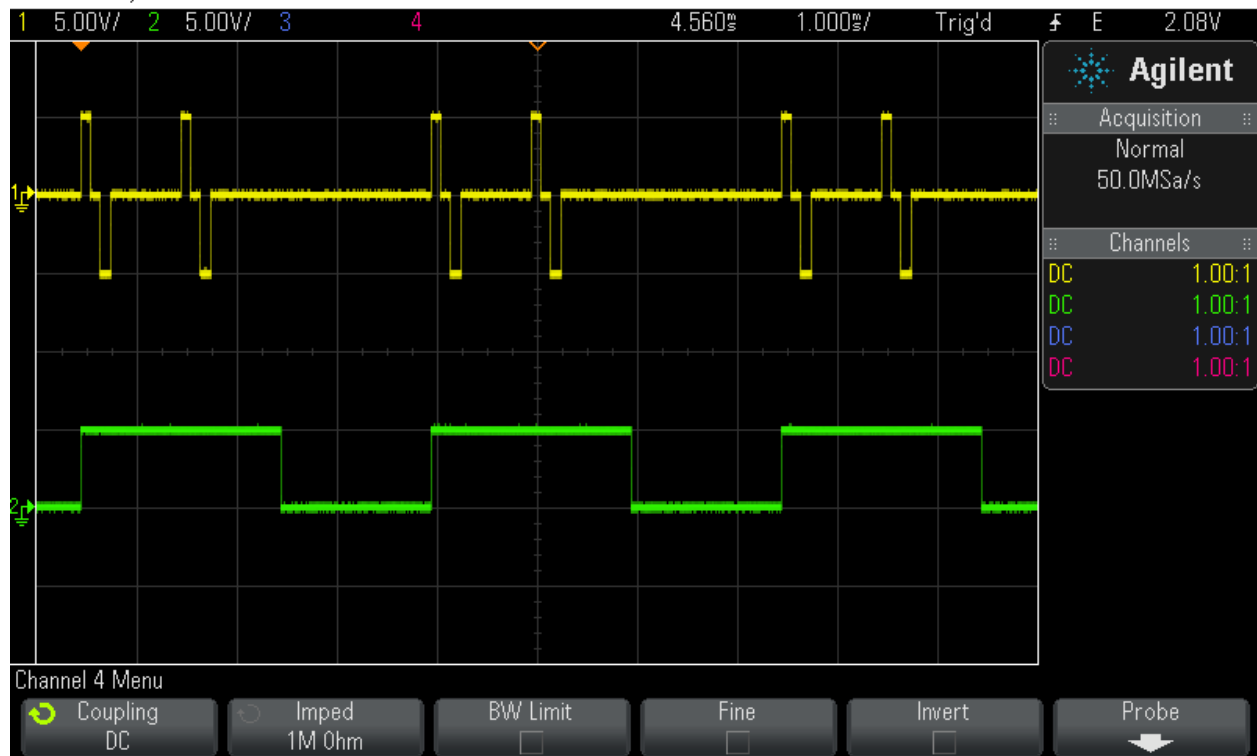


You should observe waveforms similar to the ones below, where the top trace is the output of Channel 3 SIG OUT and the lower trace is the output of Channel 3 SYNC.

In the PC control program, for channel 3, edit the signs of “Phase 1” and “Phase 2” and the polarity of the waveform should invert.

**Figure 30. Examples.ams Test Program – Channel 3 Biphasic**

MS0-X 3024A, MY51136212: Mon Nov 28 10:45:50 2011



## Stepped Waveform

Configure your oscilloscope to trigger off of Channel 1 SYNC.

Connect Channel 4 SIG OUT to your oscilloscope channel 1 signal in.

Connect Channel 4 SYNC to your oscilloscope channel 4 signal in.

Set your oscilloscope channel gains to 5V/div and your scope timebase to 1ms/div.

Enable the Model 3800 by clicking on the global enable button:

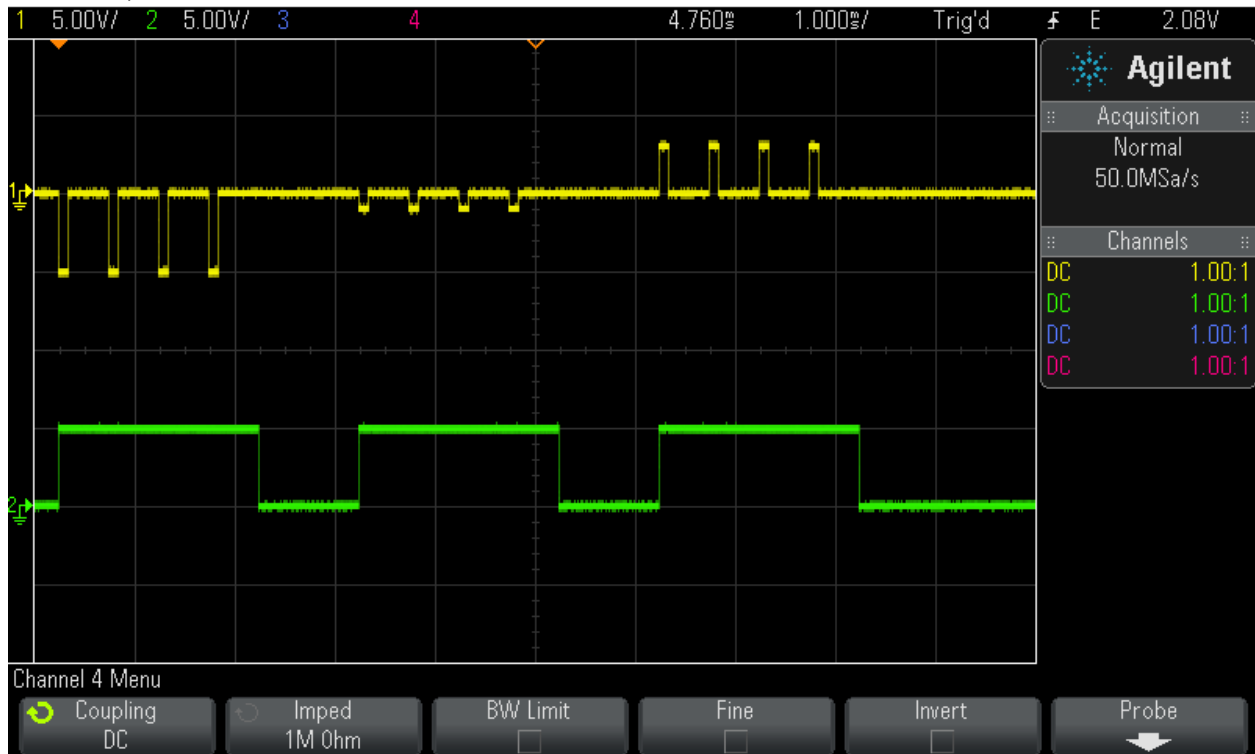


You should observe waveforms similar to the ones below, where the top trace is the output of Channel 4 SIG OUT and the lower trace is the output of Channel 4 SYNC.

Note the increasing amplitude of the waveforms, incrementing every train (lower sync traces)

**Figure 31. Examples.ams Test Program – Channel 4 Stepped**

MSO-X 3024A, MY51136212: Mon Nov 28 10:44:31 2011



## Paired Waveform

Configure your oscilloscope to trigger off of Channel 1 SYNC.

Connect Channel 5 SIG OUT to your oscilloscope channel 1 signal in.

Connect Channel 5 SYNC to your oscilloscope channel 4 signal in.

Set your oscilloscope channel gains to 5V/div and your scope timebase to 1ms/div.

Enable the Model 3800 by clicking on the global enable button:

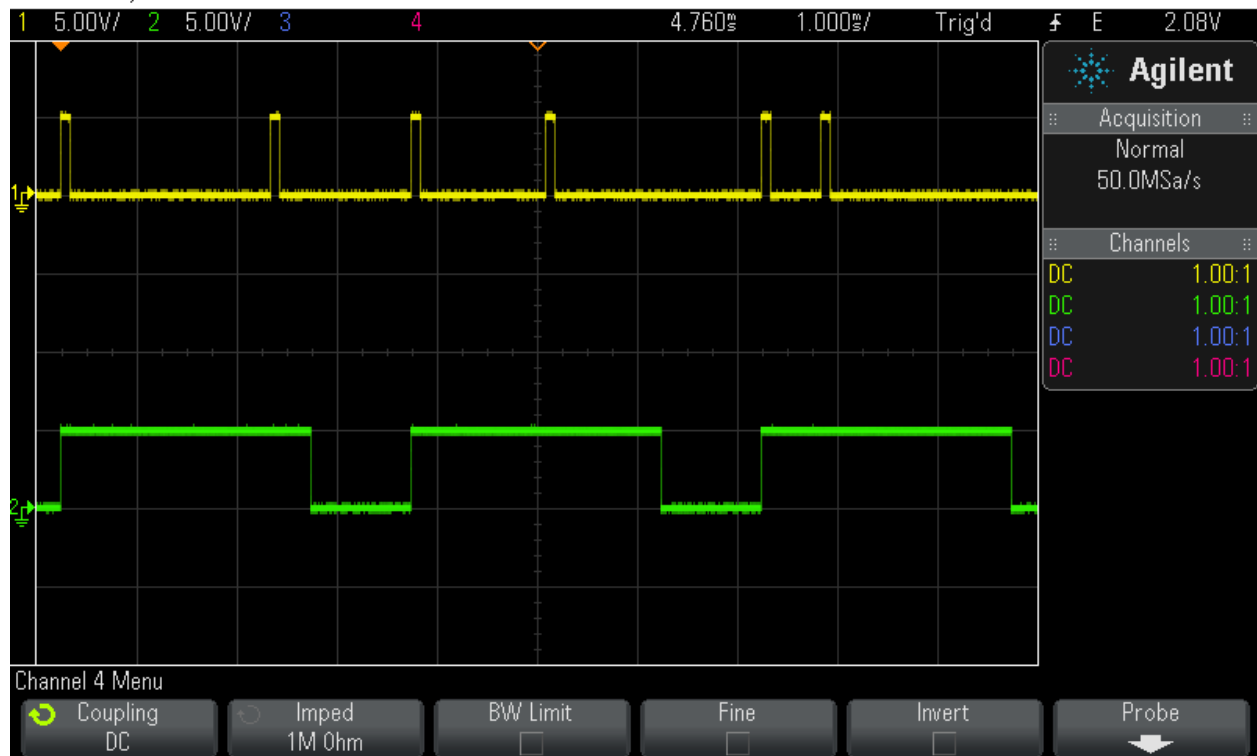


You should observe waveforms similar to the ones below, where the top trace is the output of Channel 5 SIG OUT and the lower trace is the output of Channel 5 SYNC.

Note the decreasing interval between pairs of waveforms, decreasing every train (lower sync traces)

**Figure 32. Examples.ams Test Program – Channel 5 Paired Pulses**

MSO-X 3024A, MY51136212: Mon Nov 28 10:44:22 2011



## Sum Out (Combination) Waveform

Configure your oscilloscope to trigger off of Channel 1 SYNC.

Connect Channel 6 SIG OUT to your oscilloscope channel 1 signal in.

Connect Channel 7 SIG OUT to your oscilloscope channel 2 signal in.

Connect Channel 8 SIG OUT to your oscilloscope channel 3 signal in.

Connect Channel 8 SUM OUT to your oscilloscope channel 4 signal in.

Set your oscilloscope channel gains to 5V/div and your scope timebase to 2ms/div.

Enable the Model 3800 by clicking on the global enable button:

You should observe waveforms similar to the ones below, where the top trace is the output of Channel 6, the 2<sup>nd</sup> trace is the output of Channel 7, the 3<sup>rd</sup> trace is the output of Channel 8 SIG OUT, and the 4<sup>th</sup> trace is the output of Channel 8 SUM OUT.

The bottom trace represents the mathematical sum of the amplitudes at each point in time of the three contributing channels, 6, 7, and 8. You can include or eliminate each channel's contribution to the combo waveform by selecting or deselecting the channel number in Channel 8's SUM OUTPUTS checklist.

**Figure 33. Examples.ams Test Program – Channel 8 Sum Out Waveforms**

MSO-X 3024A, MY51136212: Mon Nov 28 10:41:13 2011

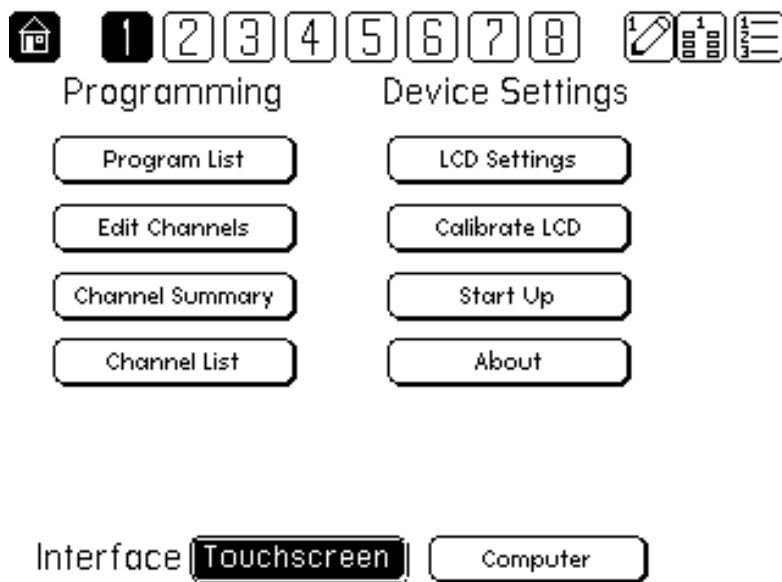


## 8. Instrument Operation via Front Panel Touchscreen

### HOME SCREEN

This section will describe how to use the touchscreen interface to control the instrument. If the instrument is still under computer control after having completed the walkthrough of the Examples.5.28.14.ams waveforms, place the instrument back in touchscreen mode by selecting the “Tools” menu at the top of the software program and then selecting “Set LCD in Control”. You will see the main home screen on the display.

Figure 34. Home Screen



## CHANNEL SCREENS

### Channel – Type Screen


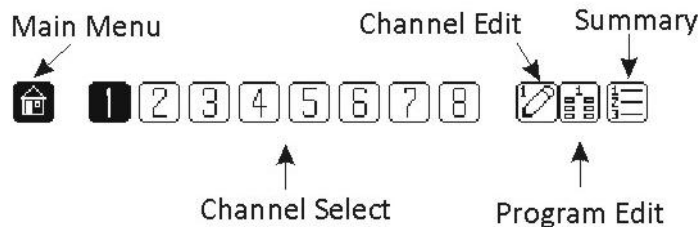
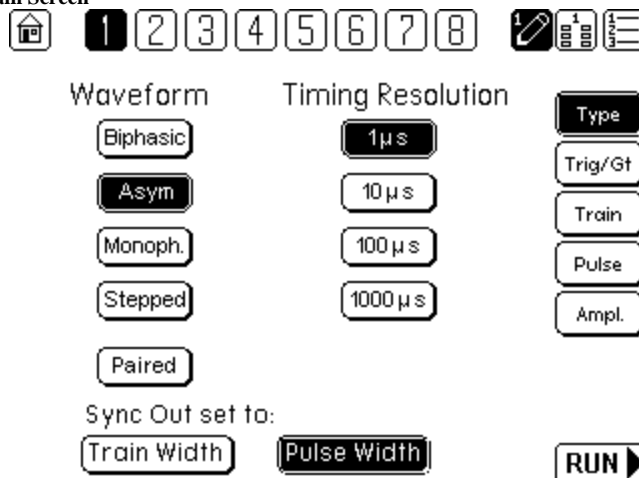
CHANNEL Screens are used to edit the parameters of a stimulator channel, and are indicated by the icon . The top line of the CHANNEL - TYPE SCREEN (as well as all other screens) is the TOOLBAR, which contains navigation icons that allow the user to navigate to key screens. The horizontal SINGLE CHANNEL SELECT LIST within the toolbar selects the channel whose settings will be edited.

Figure 35. Toolbar



On the CHANNEL - TYPE screen, the type of *WAVEFORM* to be delivered, the *TIMING RESOLUTION* of the channel, the *SYNC* options for the channel, and links to relevant channel parameters are displayed. This screen is indicated by the highlighted “Type” icon at the right side of the screen. Each of the buttons at the right side of the screen are active links to other parameter setting screen. Pressing any value displayed in any list will highlight that value, and will immediately set that channel’s parameter to the selected value. If more settings are available than can be displayed in a list, an up or down arrow will be displayed which will shift the list accordingly if pressed.

Figure 36. Channel - Train Screen





## Waveform

As described in the walkthrough of the test waveforms, each channel can deliver one of five waveform types on its SIGNAL OUT connector. Each of these waveform types can be summed with other waveform types generated by other channels on each channels' COMBO OUTPUT. For now, this discussion will focus on waveform obtained at the channel's SIGNAL OUT BNC connector. Examples of each waveform are discussed in detail in Chapter 7

- Biphasic*** Delivers a pulse waveform consisting of two equal amplitude phases, where the sign of each phase can be set in the amplitude screen. A single value sets the amplitude of each pulse.
- Asym*** Delivers a pulse waveform consisting of two phases, where the amplitude of the two phases can be different. The sign of each phase can be set in the amplitude screen.
- Monophasic*** Delivers a pulse waveform consisting of a single positive or negative amplitude which is set in the amplitude screen.
- Stepped*** Delivers pulse trains where pulse amplitudes increase or decrease by a constant value between trains
- Paired*** Delivers trains consisting of pulse pairs where the interpulse interval increases or decreases by a constant value between trains

## Timing Resolution

The timing resolution can be set on each channel to 1us, 10us, 100us, and 1ms. Timing resolution defines the minimum duration of a pulse, as well as the total duration of timing for each channel. When summing signals from

**Table 1. Timing Resolution**

Setting	Maximum Train Duration
1uS	15 minutes
10uS	2.5 hours
100uS	25 hours
1000uS	250 hours

## Sync Out

The TTL level output at the channel's front panel SYNC OUT BNC can be set to:

- Train Width** Voltage goes high (5V) during train on; low (0V) in between trains.
- Pulse Width** Voltage goes high (5V) while pulse width is being timed; low (0V) in between pulses.

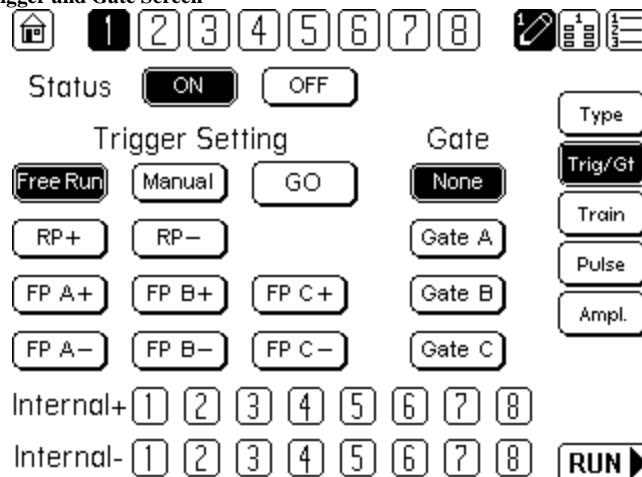
## HOLD/RUN

On all Channel Edit screens the HOLD/RUN button turns off/on all instrument channels simultaneously.

## Channel – Trigger and Gate Screen

The CHANNEL - TRIG/GT SCREEN determines trigger and gating parameters of a single channel. This screen is indicated by the highlighted “Trig/Gt” icon at the right side of the screen.

Figure 37. Channel – Trigger and Gate Screen



## Trigger Setting

- Free Run** Trigger pulses internally generated. Immediately after cessation of one train, next train timing sequence will begin.
- Manual** Train timing initiated by pressing of MANUAL TRIGGER GO button
- FP A+, A-...** Train timing initiated by presentation of 5V TTL signal to front panel A, B, or C connector. (+) will initiate timing on rising/leading edge of BNC input signal; (-) will initiate timing on falling/trailing edge of BNC input signal. Any channel (s) can be associated with any of the three front panel trigger BNCs.

***RP+, RP-*** Train timing initiated by presentation of 5V TTL signal to the rear panel dedicated trigger for that channel. (+) will initiate timing on rising/leading edge of BNC input signal; (-) will initiate timing on falling/trailing edge of BNC input signal.

***Int Ch1+, Int Ch1-...*** Train timing initiated by another channel's SYNC OUT timing (TRAIN WIDTH or PULSE WIDTH; internal connection made; no BNC cable required).

***Go*** Initiates trial timing when in MANUAL TRIGGER mode

## **Gate**

***None*** Timing proceeds as normal.

***Gate A*** Determines the source of the voltage level that will pause channel operation

***Gate B*** When Trigger is set to FREE RUN, pressing the "GO" Manual trigger button will initiate channel timing.

***Gate C*** Determines if the channel is OFF, and no timing sequence is being generated, or ON, where timing and outputs are being generated according to the rules of triggering.

## **Channel Status**

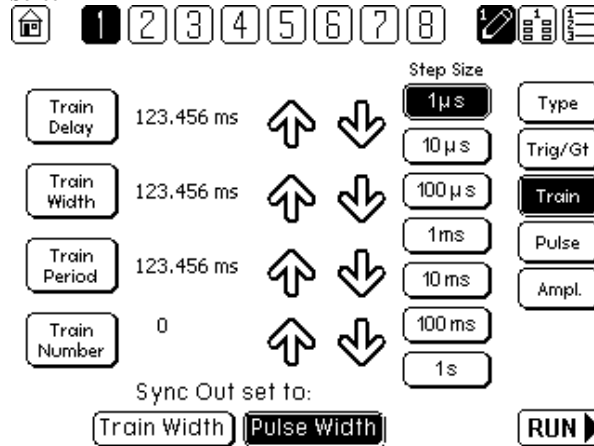
***Off*** All channel timing is disabled. Trigger inputs ignored.

***On*** All channel timing is enabled. Trigger inputs are followed.

## Channel – Train Screen

The CHANNEL EDIT-TRAIN SCREEN determines basic train timing parameters of a channel.

Figure 38. Channel – Train Screen



**Train Delay** Determines the time delay between the trigger and generation of pulses.

*Note: TD must be set to a minimum of 0.001usec (or the smallest time unit available)*

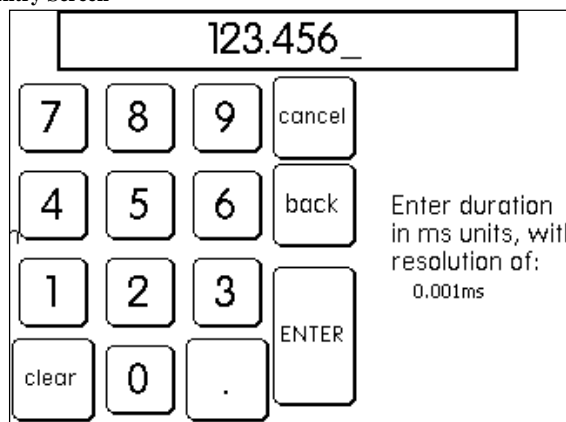
**Train Width** Determines the duration of a single train

**Train Period** Determines the interval between successive train onsets.

**Train Number** Determines the number of trains to be initiated by a single trigger.

Pressing the up/down arrows next to the corresponding value will quickly adjust the entered value. The Step Size of each arrow press is determined by the column to the right of the arrows. By pressing the Train Delay, Train Width, or Train Period icon itself, the user will be lead to a numeric entry screen where the values can be manually entered:

Figure 39. Numerical Time Entry Screen

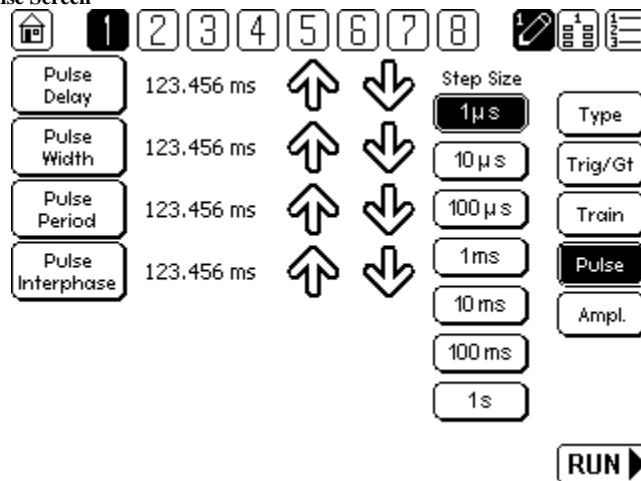


## Channel – Pulse Screen

The CHANNEL PULSE SCREEN is used to determine basic pulse parameters of a stimulator channel.

- Pulse Delay** Determines the time delay between the end of the train delay period and the generation of the first pulse.
- Pulse Width** Determines the duration of a single pulse. In the case of Biphasic pulses, Pulse Width sets the duration of each phase. (biphasic pulses must have phases of equal duration. To obtain biphasic pulses with different pulse widths for each phase, separate channels should be used for each phase, and their outputs summed on a channel's SUM OUT BNC.)
- Pulse Period** Determines the interval between successive Pulse onsets.
- Pulse Interphase** Determines the interval between two phases of a biphasic pulse.
- Space Pol** *Displayed for Paired Pulse waveform type only.* Determines if the interval between the paired pulses will increase or decrease between successive trains.
- Space Start** *Displayed for Paired Pulse waveform type only.* Determines initial interpulse duration for the paired pulses.
- Space Change** *Displayed for Paired Pulse waveform type only.* Determines the increment of timing change applied between successive trains.

Figure 40. Channel – Pulse Screen



Once again, the values can be set by selecting your step size and using the arrow keys to scroll or by pressing Pulse Delay, Pulse Width, Pulse Period, or Pulse Interphase which will lead to a numeric entry screen.

## Channel – Amplitude Screen

The CHANNEL - PULSE SCREEN is used to determine basic train and pulse amplitudes of a stimulator channel.

Figure 41. Channel – Amplitude Screen, Biphasic Pulse

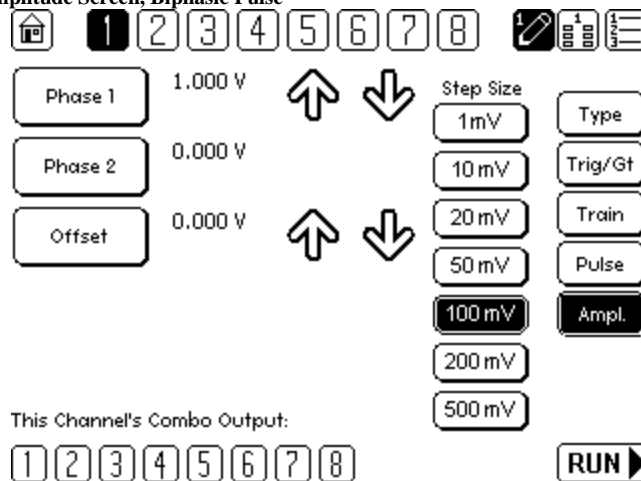
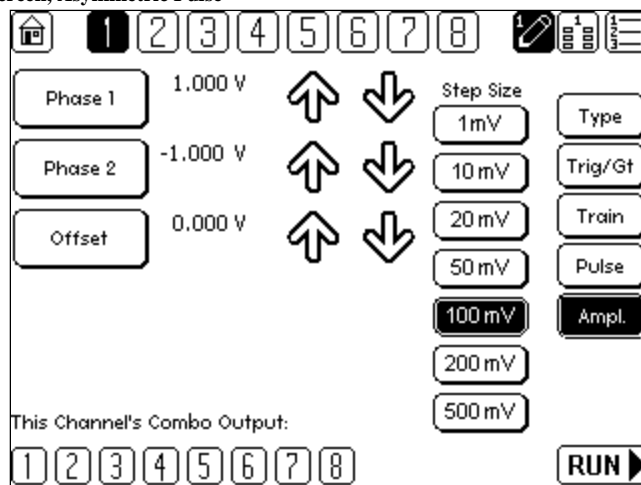


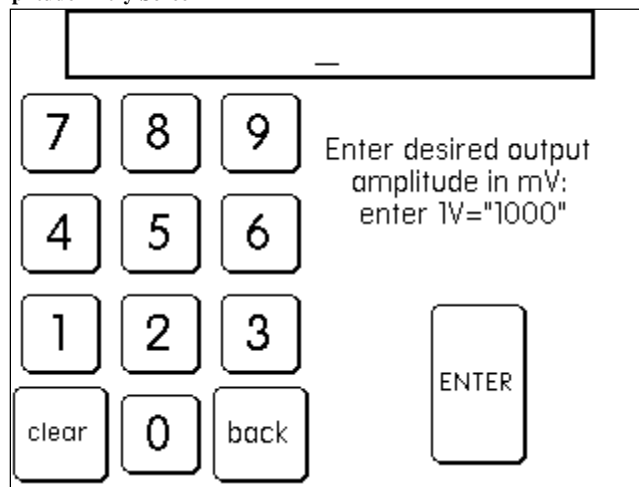
Figure 42. Amplitude Screen, Asymmetric Pulse



- Phase 1** Determines the amplitude of the first part of a biphasic pulse. In the case of Monophasic pulses, Only Phase 1 is displayed and set.
- Phase 2** Determines the amplitude of the second part of a asymmetric pulse. In the case of Monophasic pulses, Only Phase 1 is displayed and set. In the case of Biphasic pulses, this is disabled (no arrows displayed either), and amplitude of this phase is equal, but opposite in polarity, to value entered for phase 1.
- Offset** Determines the interval between successive Pulse onsets.
- Amplitude Start** *Displayed for Stepped waveform type only.* Determines initial pulse amplitude..
- Amplitude Change** *Displayed for Stepped waveform type only.* Determines the increment in pulse amplitude applied between successive trains.
- Combo Output** Controls output signal present at SUM OUT BNC. SIG OUT of any selected (highlighted) channel number is summed and available at SUM OUT. Note: This includes the output of the particular channel itself. The SUM OUT of channel 1 will not reflect Channel 1 SIG OUT unless the "1" is selected under Combo Output.

Values can be set using the arrows or by pressing Phase 1, Phase 2, or Offset which will lead to a numeric entry screen:

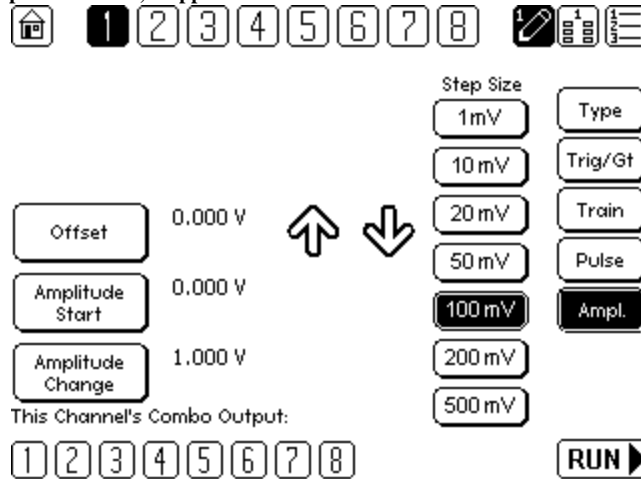
**Figure 43. Numerical Amplitude Entry Screen**



## Channel – Stepped Amplitude Screen

The CHANNEL - PULSE SCREEN is used to determine basic pulse amplitudes of a train of pulses stepping in amplitude magnitude.

Figure 44. Channel – Amplitude Screen, Stepped Pulse



**Offset** Determines the interval between successive Pulse onsets.

**Amplitude Start** *Displayed for Stepped waveform type only.* Determines initial pulse amplitude..

**Amplitude Change** *Displayed for Stepped waveform type only.* Determines the increment in pulse amplitude applied between successive trains. Can be positive or negative.

**Combo Output** Controls output signal present at SUM OUT BNC. SIG OUT of any selected (highlighted) channel number is summed and available at SUM OUT. Note: This includes the output of the particular channel itself. The SUM OUT of channel 1 will not reflect Channel 1 SIG OUT unless the “1” is selected under Combo Output.

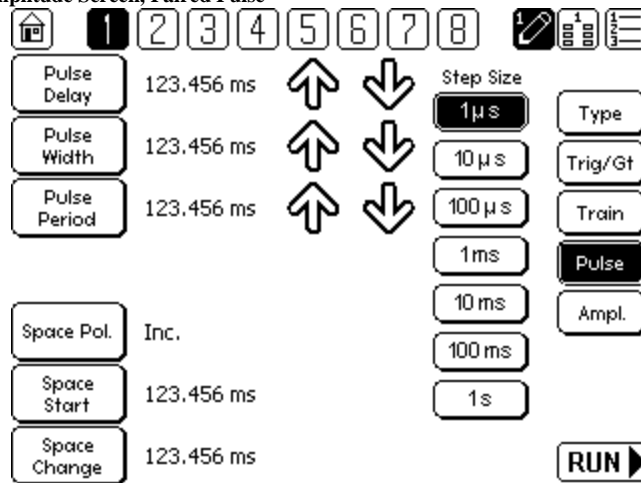
The Stepped pulse protocol is based upon monophasic pulses. To make stepped biphasic pulses, you need to use combine the outputs of multiple channels set to monophasic stepping pulses, delayed in time, where each channel would control the amplitude of one of the biphasic pulse phases.



## Channel – Paired Pulse Screen

The CHANNEL - PULSE SCREEN is used to determine basic train and pulse amplitudes of a stimulator channel.

Figure 45. Channel – Amplitude Screen, Paired Pulse




- Pulse 1** Determines the amplitude of the first part of a biphasic pulse. In the case of Monophasic pulses, Only Phase 1 is displayed and set.
- Pulse 2** Determines the amplitude of the second part of a biphasic pulse.
- Offset** Determines the interval between successive Pulse onsets.
- Space Pol.** *Displayed for Paired waveform type only.* Determines if change in paired pulse interval is increasing or decreasing.
- Space Start** *Displayed for Paired waveform type only.* Determines the initial time interval between the pulse and its paired partner.
- Space Change** *Displayed for Paired waveform type only.* Determines the increment in time interval between paired pulses that is applied between successive trains.
- Combo Output** Controls output signal present at SUM OUT BNC. SIG OUT of any selected (highlighted) channel number is summed and available at SUM OUT. Note: This includes the output of the particular channel itself. The SUM OUT of channel 1 will not reflect Channel 1 SIG OUT unless the "1" is selected under Combo Output.

The Paired pulse protocol is based upon monophasic pulses. To make paired biphasic pulses, you need to use combine the outputs of multiple channels set to monophasic paired pulses, delayed in time, where each channel would control the timing of one of the biphasic pulse phases.

## PROGRAM SCREENS

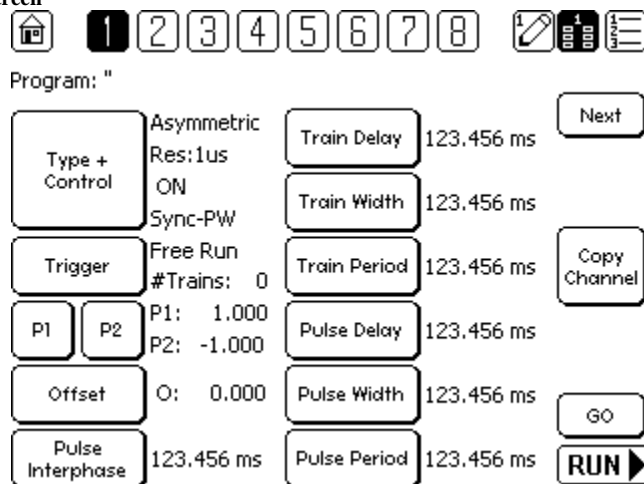
### Program 1 Screen

PROGRAM EDIT Screens are used to edit/review the parameters of a “program”, enabling an overview of all of the critical timing and amplitude parameters used to define a stimulus train, and are indicated by the icon 

On the PROGRAM - SIGNAL screen, all parameters for the channel selected/indicated by the highlighted number in the upper toolbar are displayed. Pressing any of the buttons leads either to a numeric entry screen, or to the relevant CHANNEL Screen to allow for modification. Pressing a non-highlighted number in the toolbar will update the display to show the values for that now selected (and now highlighted) channel.

Actual buttons / information displayed will vary depending on the waveform type selected for that channel. For example, on monophasic pulses, the information for the non-existent second phase of the pulse (P2) will not be displayed.

Figure 46. Program 1 Screen



# SUMMARY SCREENS

## Summary -Train Screen



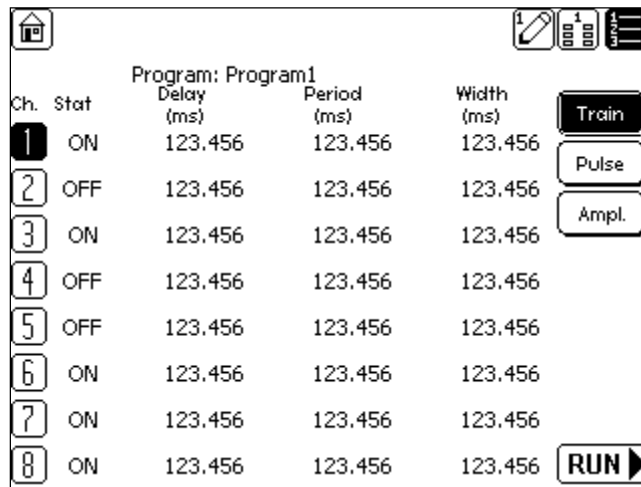
SUMMARY TRAIN Screens are used to review the major parameters of all 8 channels at once, enabling an overview of all of the critical timing and amplitude parameters used to define a stimulus train, and are indicated by the icon . The only links on the SUMMARY screens are the vertical channel select numbers. Highlight a number, then pressing the CHANNEL Screen icon  will direct you to the Channel edit screen for that selected channel.

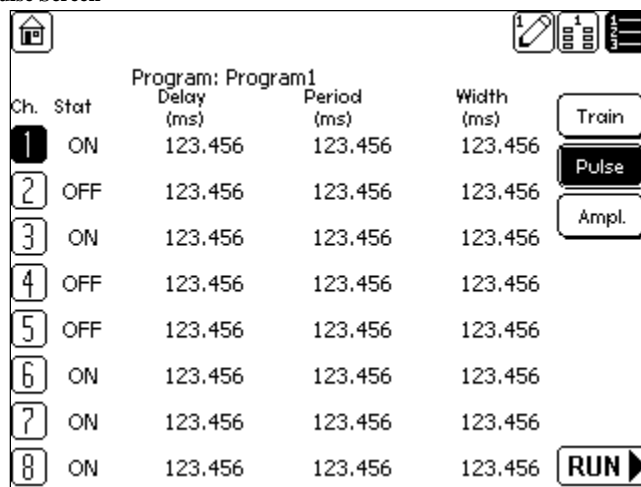
Figure 47. Summary - Train Screen



Ch.	Stat	Delay (ms)	Period (ms)	Width (ms)	
1	ON	123.456	123.456	123.456	Train
2	OFF	123.456	123.456	123.456	Pulse
3	ON	123.456	123.456	123.456	Ampl.
4	OFF	123.456	123.456	123.456	
5	OFF	123.456	123.456	123.456	
6	ON	123.456	123.456	123.456	
7	ON	123.456	123.456	123.456	
8	ON	123.456	123.456	123.456	RUN ▶

## Summary - Pulse Screen

Figure 48. Summary - Pulse Screen



Ch.	Stat	Delay (ms)	Period (ms)	Width (ms)	
1	ON	123.456	123.456	123.456	Train
2	OFF	123.456	123.456	123.456	Pulse
3	ON	123.456	123.456	123.456	Ampl.
4	OFF	123.456	123.456	123.456	
5	OFF	123.456	123.456	123.456	
6	ON	123.456	123.456	123.456	
7	ON	123.456	123.456	123.456	
8	ON	123.456	123.456	123.456	RUN ▶

## Summary - Amplitude Screen

Figure 49. Summary – Amplitude Screen

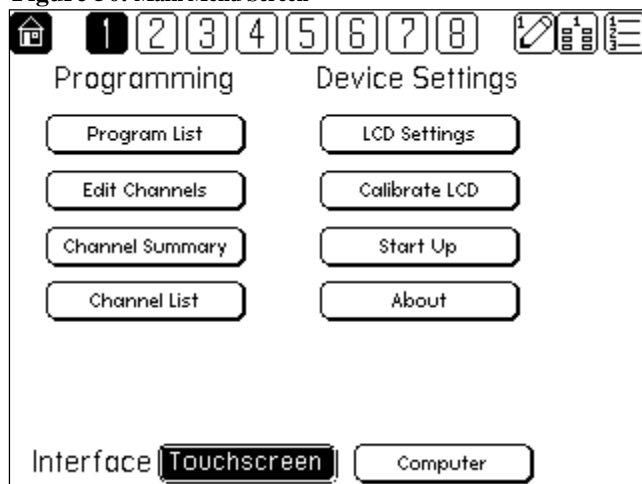
Ch.	Stat	Type	P1	P2	Offset	
1	ON	Biphasic+	1.000	0.000	0.000	Train
2	OFF	Biphasic-	0.000	0.000	1.000	Pulse
3	ON	MonPhasic+	10.000	-1.000	-10.000	Ampl.
4	OFF	MonPhasic-	1.232	-10.000	0.232	
5	OFF	Stepped	1.232	-10.000	1.232	
6	ON	Paired	1.232	-10.000	0.000	
7	ON	Stepped	1.232	-10.000	0.000	
8	ON	MonPhasic-	1.232	-10.000	0.000	RUN ▶

## SYSTEM CONTROL SCREENS

### Main Menu Screen

Options on the MAIN MENU screen are grouped according to Programming, and Device Settings.

Figure 50. Main Menu Screen

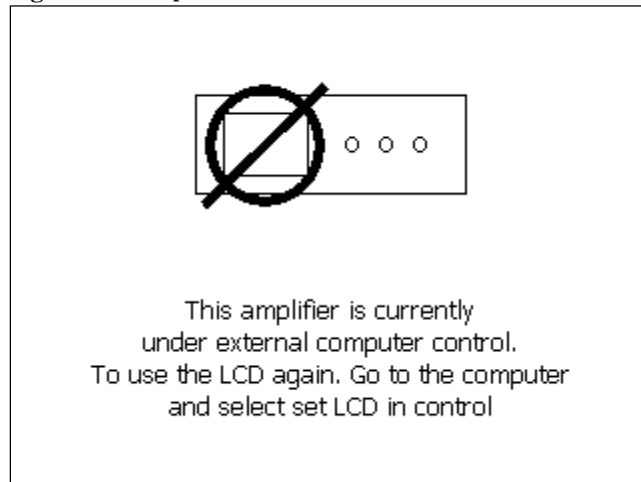


Selecting COMPUTER for the interface will disable the touch screen interface, and transfer control of the Model 3800 over to the computer. Any ongoing timing and output at time of transfer WILL CONTINUE. To gain complete control of the instrument via the computer, an additional command needs to be selected by the computer program (will be covered in PC code section).

## **Computer in Control Screen**

When under computer control, the following screen is displayed on the front panel.

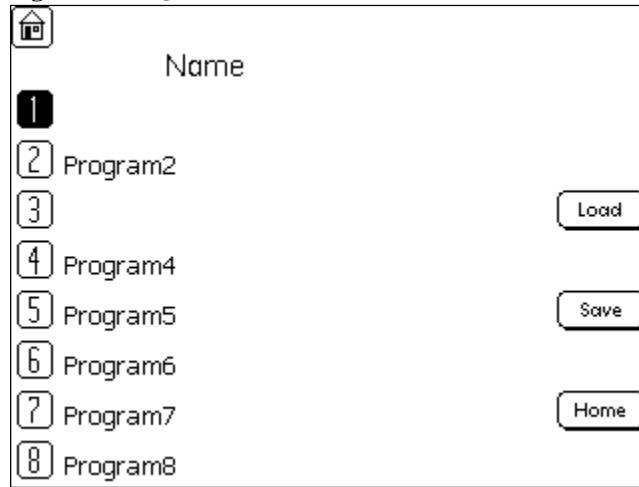
**Figure 51. Computer in Control Screen**



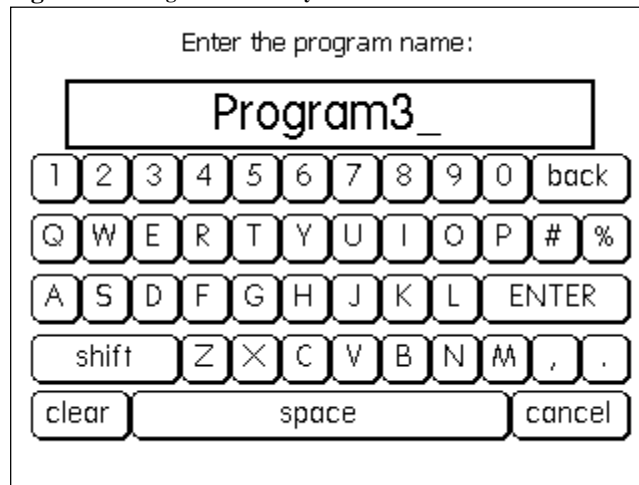
## Program Storage Screens

Users can store up to 8 programs in memory on the Model 3800. Each program, consisting of all parameters of all 8 channels, can be saved to memory and named via these screens. (See following page).

**Figure 52. Program List Screen**



**Figure 53. Program Name Keyboard Screen**

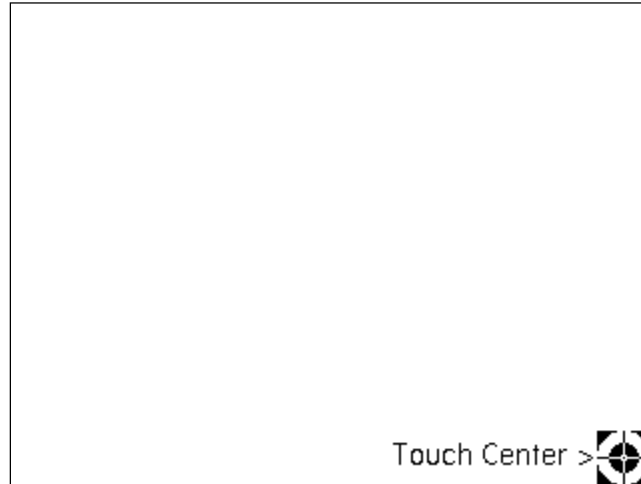




## Setup – Calibrate LCD Screen

These 3 screens calibrate the instrument to respond to your finger press.

**Figure 56.** Setup – Calibrate LCD Screen

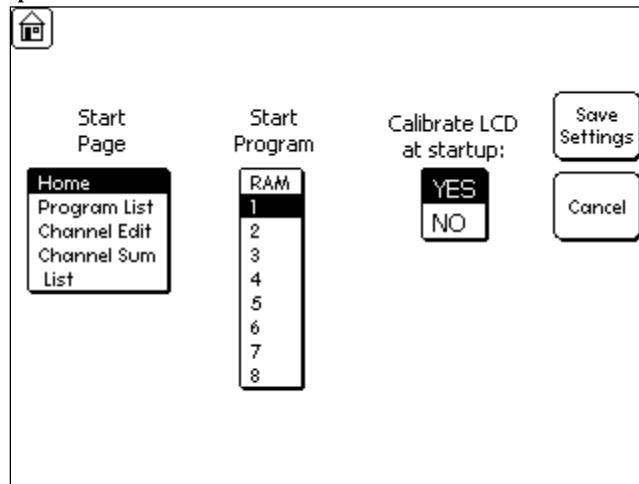




## Setup – Start Up Screen

This screen determines parameters to be loaded everytime the Model 3800 MultiStim is turned on.

Figure 57. Setup – Start Up Screen

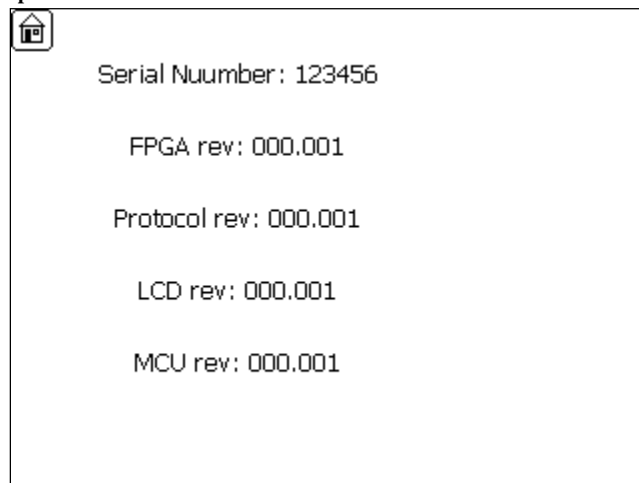


Start Program will load the program file stored in the selected memory location (1 to 8).

## Setup – About Screen

This screen lists various revs of your Model 3800 MultiStim.

Figure 58. Setup – Start Up Screen



## 9. Specifications

Wide timing range: 1  $\mu$ s to 250 hours

Minimum monophasic pulse duration: 1  $\mu$ s

Minimum biphasic pulse duration: 2  $\mu$ s

Minimum pulse interval: 3  $\mu$ s

Excellent timing accuracy: better than 0.02%,

Calibrated voltage output:  $\pm 10$  V with 1 mV resolution (single channel output)

Voltage \ Current output via optional SIU:  $\pm 60$  V @ 10mA with 500kHz bandwidth

8 dedicated rear panel BNC triggers

## 10. Warranty

### A-M SYSTEMS, LLC LIMITED WARRANTY

#### **What does this warranty cover?**

A-M Systems, LLC (hereinafter, “A-M Systems”) warrants to the Purchaser that the Instruments manufactured by A-M Systems (hereinafter the “hardware”), and sold after January 1, 2020, is free from defects in workmanship or material under normal use and service for the lifetime of the hardware. Headstages manufactured by A-M Systems and sold after January 1, 2020, will be repaired under warranty only once per year. This warranty commences on the date of delivery of the hardware to the Purchaser. “Lifetime” is defined as the time all components in the instrument can still be purchased from mainstream, common, electronic component distributors such as Digi-Key Electronics, Newark, or Mouser Electronics.

For hardware sold prior to January 1, 2020, the warranty in effect at time of purchase applies, with the maximum warranty period of three (3) years for new purchases, and one (1) year for those that have been repaired by A-M Systems. For headstages manufactured by A-M Systems and sold prior to January 1, 2020, the maximum warranty period is one (1) year.

#### **What are the obligations of A-M Systems under this warranty?**

During the warranty period, A-M Systems agrees to repair or replace, at its sole option, without charge to the Purchaser, any defective component part of the hardware. To obtain warranty service, the Purchaser must return the hardware to A-M Systems or an authorized A-M Systems distributor in an adequate shipping container. Any postage, shipping and insurance charges incurred in shipping the hardware to A-M Systems must be prepaid by the Purchaser, and all risk for the hardware shall remain with Purchaser until A-M Systems takes receipt of the hardware. Upon receipt, A-M Systems will promptly repair or replace the defective unit and then return the hardware (or its replacement) to the Purchaser with postage, shipping, and insurance prepaid by the Purchaser. A-M Systems may use reconditioned or like-new parts or units at its sole option, when repairing any hardware. Repaired products shall carry the same amount of outstanding warranty as from original purchase. Any claim under the warranty must include a dated proof of purchase of the hardware covered by this warranty. In any event, A-M Systems liability for defective hardware is limited to repairing or replacing the hardware.

## LIMITED WARRANTY, cont

### **What is not covered by this warranty?**

This warranty is contingent upon proper use and maintenance of the hardware by the Purchaser and does not cover batteries. Neglect, misuse whether intentional or otherwise, tampering with or altering the hardware, damage caused by accident, damage caused by unusual physical, electrical, chemical, or electromechanical stress, damage caused by failure of electrical power, or damage caused during transportation are not covered by this warranty.

Further, no guarantee is made regarding software compatibility with future updated operating systems. Products may not be returned to A-M Systems for service, whether under warranty or otherwise, which are contaminated by infectious agents, radioactive compounds or other materials constituting a health hazard to employees of A-M Systems

### **What are the limits of liability for A-M Systems under this warranty?**

A-M Systems shall not be liable for loss of data, lost profits or savings, or any special, incidental, consequential, indirect or other similar damages, whether arising from breach of contract, negligence, or other legal action, even if the company or its agent has been advised of the possibility of such damages, or for any claim brought against you by another party.

**THIS EQUIPMENT IS NOT INTENDED FOR CLINICAL MEASUREMENTS USING HUMAN SUBJECTS.  
A-M SYSTEMS DOES NOT ASSUME RESPONSIBILITY FOR INJURY OR DAMAGE DUE TO MISUSE  
OF THIS EQUIPMENT.**

Jurisdictions vary with regard to the enforceability of provisions excluding or limiting liability for incidental or consequential damages. Check the provision of your local jurisdiction to find out whether the above exclusion applies to you.

This warranty allocates risks of product failure between the Purchaser and A-M Systems. A-M Systems hardware pricing reflects this allocation of risk and the limitations of liability contained in this warranty. The agents, employees, distributors, and dealers of A-M Systems are not authorized to make modifications to this warranty, or additional warranties binding on the company. Accordingly, additional statements such as dealer advertising or presentations, whether oral or written, do not constitute warranties by A-M Systems and should not be relied upon. This warranty gives you specific legal rights. You may also have other rights which vary from one jurisdiction to another.

**THE WARRANTY AND REMEDY PROVIDED ABOVE IS IN LIEU OF ALL OTHER WARRANTIES AND REMEDIES, WHETHER EXPRESS OR IMPLIED. A-M SYSTEMS DISCLAIMS THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR USE, WITHOUT LIMITATION.**

A-M Systems,  
:

3800 Manual

DRW-5027908 Rev 5

#### Revision History

Rev	Date	Description
1	11/28/11	Initial Document Release
2	4/25/13	Revised with new SIU, Amulet rev
3	5.28.14	Introduce Minimum TD setting, Change pn from 5027908 to 1027908
4	1/18/19	DCR 202615. Update manuals for content part numbers
5	3/19/20	DCR 203316. Update Warranty

